MEN
AND
MERIDIANS

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6, 44, 45, 46.	Geol. Surv. Can. 81496, 73331, 81367, 68775.
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12.	McCord Mus., McGill Univ., Montreal.
13, 17, 19, 38, 43.	Confederation Life Collection.
14.	Nova Scotia Dept. Lands & Forests, Halifax.
16, 18, 35.	Public Arch. Can. A965, C1531, C10868.
20.	Quebec Hist. Soc.
21.	Nat. Mus. Can. J2533.
22.	Nat. Gallery Can. 8000.
23.	Vancouver Sch. Bd., K618.
24, 26, 27, 28.	Ont. Dept. Public Rec. & Arch., Toronto.
25.	Ont. Dept. Lands & Forests, Toronto.
29.	Ont. Dept. Travel & Publicity.
31.	Ont. Dept. Public Rec. & Arch. (Ont. Hist. Soc.).
32.	C. F. J. Whebell, Univ. Western Ontario.
33.	Int. Boundary Comm. Rept. 1934.
36.	Can. Geog. J., July, 1964.
39, 40, 41, 42.	Prov. Arch., Victoria, B.C.

MEN AND MERIDIANS

The History of Surveying and Mapping in Canada

Volume I
Prior to 1867

Don W. Thomson

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Available in Canada through

Authorized Bookstore Agents
and other bookstores

or by mail from

Canadian Government Publishing Centre
Supply and Services Canada
Ottawa, Canada K1A 0S9

Catalogue No. M 52-2066-1 Canada: $10.00
ISBN 0-660-11558-1 Other countries: $12.00

Price subject to change without notice

Ottawa 1966

Reprinted 1975, 1984

Preface

In a country as dependent as Canada upon the arts of surveying and mapping it is surprising to find both fields so neglected in history books. True, several excellent historical atlases have been published in fairly recent years but the main story of Canadian surveying has never been published in any major, comprehensive or coherent form. This large gap in the written record of Canada's growth and achievements is all the more surprising when it is realized that surveying and mapping have played roles of primary importance in contributing to the orderly settlement of the land, in promoting the greater safety and efficiency of navigation in our waters and in the location and development of the renewable and non-renewable natural resources of this country. These resources include in addition to land, the fisheries, water, forests, wildlife, waterpower, minerals, and recreational facilities of Canada. In the related fields of town planning and highway construction, and in multiple-resource regions these roles have been and continue to be highly significant in the task of nation-building.

Surveying and mapping contribute in a continuing way to national growth and wellbeing. To these activities Canadians owe the fundamental order and symmetry of their urban communities. Through a system of precise definitions these arts have bestowed beauty and visual distinction upon the distribution of land holdings. The development of the spirit of possession in the private individual made inevitable the work of the surveyor and the mapper. No subject, other than politics or religion, is more difficult to discuss without arousing deep passions than that of disputed national boundaries. And none, more than surveyors and mappers, have done so much to prevent nations from resorting to war, or for that matter, individuals from going to law.

In recent times the word "survey" has taken on a wide variety of meanings, some of them only remotely related to the word's original definition. The term has now come to signify, in addition to surveys of land, sky or water, surveys of public opinion, of slum conditions, of radio or television programs, of election results, hospital facilities, industrial trends and even of human habits. This history does not pretend to extend to these more or less exotic activities. In this story there will be an attempt, rather, to portray the origin and growth of the very considerable range of Canadian surveys of land and mineral resources; the hydrographic or nautical surveys of our three coasts and inland waters; of international and provincial boundaries and of surveys cadastral, geodetic, magnetic, topographical and astronomical.

All of these diverse pursuits have evoked in men and women the very best qualities of physical and mental endurance and resourcefulness; of determination in the face of formidable odds, of unselfishness, good humor in the teeth of real hazards and, above all, a spirit of profound dedication. In so many instances in the story of Canada have these qualities of heart been so allied to gifts of mind and to the product of intensive training, that they provide a truly memorable epic of constructive achievement.

What is the surveyor's task? It is to measure the natural features of the earth and its waters, to scan the heavens, to locate and fix the boundaries of areas into which man has decided to divide this planet and to determine precise dimensions, directions and relative positions. The mapper, for his part, meets the urgent need of man to see his locality, his nation and his world as a whole and in relation the one to the other; to orient himself and his interests within his earthly and heavenly environment.

But when a surveyor has completed his measuring and the mapper his accumulation of facts, there remains the task of putting results in a form readily understood by others. In like manner through this history there runs the endeavor to trace and to interpret the deeds and accomplishments of the explorers, mappers and surveyors of Canada from the days of compasses and chains to the use of transits, tellurometers and helicopters.

The opportunity to relate, in a comprehensive and coherent manner, the story of surveying and mapping in Canada has been provided by a relatively small company of men of imagination and vision. To Carl W. Lester of Edmonton, who retired in 1964 as Director of Surveys for Alberta, belongs credit for the initial concept. In February, 1962, Mr. Lester, at the time immediate past president of the Canadian Institute of Surveying, by letter conveyed the idea of this history-writing project to the then federal Minister of Mines and Technical Surveys. With the approval, first of Hon. Mr. Martineau, and then of Hon. Mr. Benidickson, it was possible for the deputy ministers of that department, Dr. Marc Boyer and his successor, Dr. W. E. van Steenburgh, to take preliminary steps to launch this formidable undertaking. To an important extent progress on this project was made possible by the enthusiastic understanding and continuing support of federal and provincial officials at policy-making levels and by the special facilities provided the author by the Department of Mines and Technical Surveys and, in particular, by the Surveys and Mapping Branch. By no means the least significant factor in the transformation of the concept into reality has been the active cooperation of officers and members of the Canadian Institute of Surveying in freely placing their services and records at the author's disposal.

* * *

In this first of three volumes of *Men and Meridians* the story of Canadian surveying and mapping has been set in the context of pre-Champlain world progress in these fields. The narrative of Canadian advances in the 17th, 18th and 19th centuries is carried up to the time of Confederation. The second volume will open with the beginning of large scale surveys of Canada's western interior.

Issued by the
DEPARTMENT OF
MINES AND TECHNICAL SURVEYS

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"We fortify in papers and in figures,
Using the names of men instead of men:"
King Henry IV (2) Act 1. Scene 3.

Introduction

The Action at Louisbourg and its Significance

By 1750 French hydrographers and French land surveyors had been more or less busily occupied for a century and a half in their respective tasks in the St. Lawrence River basin. Nowhere else in the world, outside European waters, was there such marine surveying activity in the seventeenth century as in the Gulf of St. Lawrence. In the realm of the cadastral it is astonishing to find today evidences of an imposing number of property-line surveys completed by 1650 on both banks of the St. Lawrence near Quebec City and on the Isle of Orleans.

The annals of French Canada abound with names of brilliant surveyors and mappers of those early times: Champlain, Franquelin, Bourdon, Jolliet, de la Rivière, Boutet, de Catalogne, de Villeneuve, de Verville, Guyon, Boutin, Father Lauzon and Father Bonnécamps. These and other pioneers wrote a unique, imperishable chapter in the history of man's measurings on the North American continent. But in the mid-eighteenth century events began to march remorselessly against the strongholds of French power in the New World. Pitt the Elder was once again in control of policy at Westminster and the British people were in the grip of war fever and in a mood for military victories. The reduction of the fortress of Louisbourg was a first objective of the campaign in America. For Louisbourg guarded the entrances to the Gulf of St. Lawrence and therefore of the river itself and the centres of power in New France.

When the fortress of Louisbourg, located on the rocky southeast shore of Cape Breton Island (Île Royale) was sighted on June 2, 1758, by Admiral Boscawen's 108 ships, carrying 14,000 men, the fate of the mother country France as a direct political power in Canada was sealed. For the final fall of Louisbourg would mean the exposure of vital communication lines between France and her St. Lawrence possessions. From the moment of troop landings on June 8th under Wolfe it was but a matter of time before capitulation of Louisbourg took place, despite the gallant showing of the relatively small French garrison. On July 27th, after more than 40 days of siege, during which the fort and town suffered severely from cannonading, Louisbourg fell for the second time within thirteen years. Yet another year was to pass before Quebec itself was captured. But the handwriting of destiny could be readily discerned on the battered walls of the fallen Cape Breton stronghold.

The final fall of Louisbourg marked in effect the end of the French regime in America, not only in the political sense but also in relation to surveying and mapping in the New World under the direction of authorities in Paris. The event marked as well the beginning of the British period leading up to Confederation in 1867. The illustrious day of Champlain, Franquelin, Jolliet, Deshayes and their successors was now on the wane. The day of Samuel Holland, James Cook, J. W. DesBarres and of John Collins was dawning. Over the horizon of the future, events and forces were already shaping developments that would lead in time to the advent of surveying and mapping of a purely Canadian character on the northern half of the continent.

As waves of the North Atlantic pounded moodily against the rocks near Flat Point and the surf rose in lazy rhythms, three men came to Louisbourg; men who by force of character, long training and scientific ability were destined to dominate the post-war era of surveying and mapping in British North America, both on land and water. In one of those odd pranks played by the spirit of historical coincidence James Cook, a master (navigator) was on H.M.S. *Pembroke*, one of Boscawen's blockading ships. After the

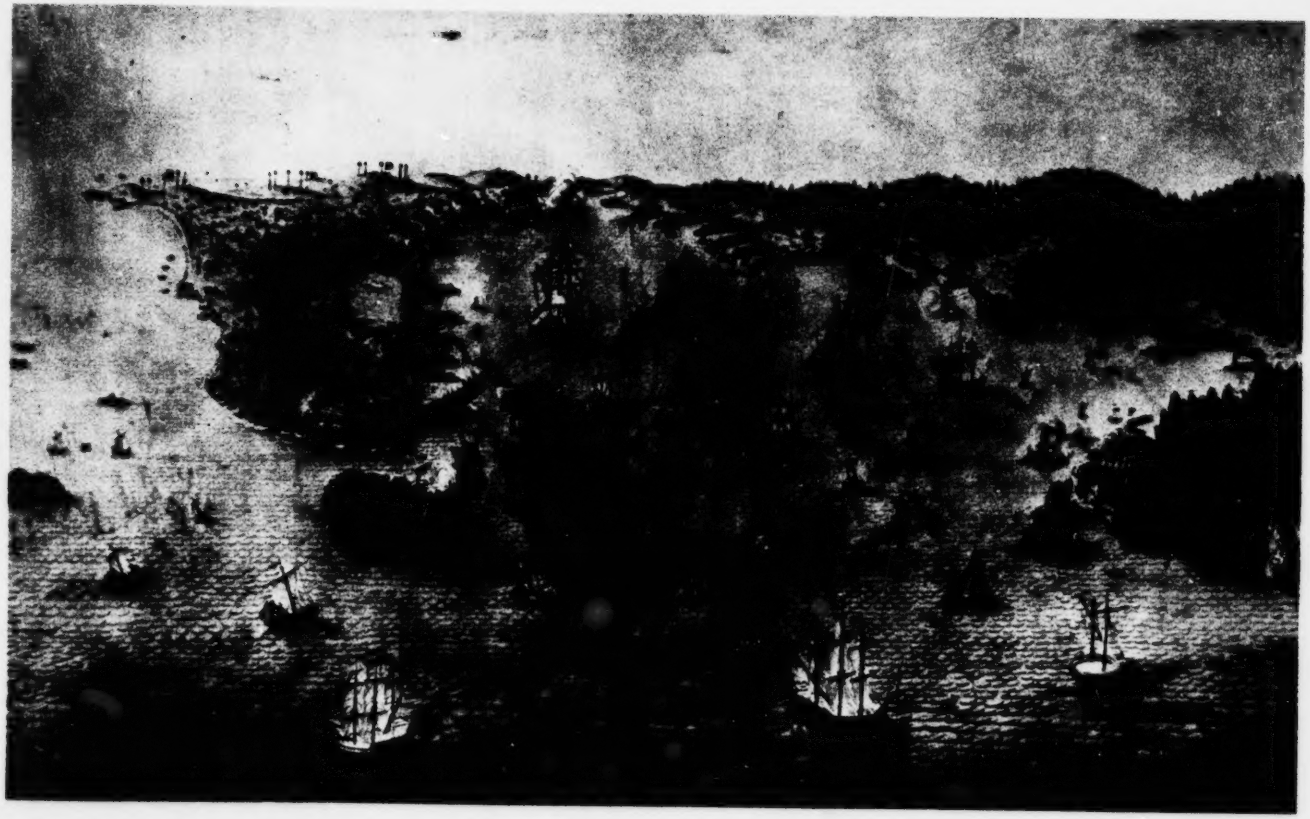


FIGURE 1. Plan of Louisbourg Fortress c. 1717, showing *jalons*, the pickets or poles used by French military surveyors in the alignment of bastions. From Cartes Marines, Paris. (Reference letters apply to points of military significance except D—left centre horizon—denoting *jalons*.)

fall of Louisburg a chance meeting brought Cook into contact with Samuel Holland. Cook proceeded to give Capt. Lieut. Holland of the Royal American Regiment of Foot assistance in drawing up a plan of Louisbourg and its fortifications. This task was, in fact, performed so admirably that both men were later engaged to prepare charts of the River and Gulf of St. Lawrence in anticipation of the following year's onslaught against Quebec. There is every indication as well that Cook also met J. W. DesBarres at Louisbourg, a man from whom the British discoverer of the future learned much of mathematics and draftsmanship.

How did these three notable men arrive in the same locality in Canada at just about the same moment in world history? James Cook came as ship's master on the *Pembroke* commanded by Capt. J. Simcoe. The vessel had sailed from England as a ship of the line to take part in the siege of Louisbourg. But in a tragic, stormy crossing of the Atlantic she lost 29 men. As a result the *Pembroke* was delayed in Halifax harbor until June 8, 1758, the very day the first successful landing of troops took place under Wolfe's direction. However, on arrival at the scene of action, the *Pembroke* did form part of Sir Charles Hardy's blockading squadron.

In the same pattern of coincidence the *Pembroke* carried another significant human link with the destiny of Canada. Capt. Simcoe was the father of John Graves Simcoe who, 34 years later, was to become the first Lieutenant Governor of Upper Canada. In that post he was to develop very close relations with Samuel Holland who, six years after the siege of Louisbourg, became Surveyor General of Quebec and the Northern District of North America.

Both Samuel Holland and Joseph F. W. DesBarres had gone to Louisbourg as officers with the Royal American Regiment of Foot, the 60th. Both served as engineers engaged in making surveys, preparing plans and taking soundings during the siege. At Gabarus Bay DesBarres, soon to become one of the world's outstanding oceanographers, was among the first to land and to capture a French entrenchment.

The day following the capitulation of Louisbourg, Holland was busily engaged in making a survey of the local fortifications and of the town and its environs. It was while he was thus occupied near Kennington Cove that he was approached by James Cook. The newcomer introduced himself and became intensely interested in the plane table employed by Capt. Lieut. Holland. Cook made known his keen desire for instruction in the use of this instrument. Upon the invitation of Capt. Simcoe, Holland a day later brought the instrument to H.M.S. *Pembroke* and remained on the vessel overnight. Next day Cook acted as one of Holland's assistants on the continuing survey at White Point. These surveying activities continued in the vicinity of Louisbourg until the end of the 1758 season.

In Halifax during the winter months Cook was introduced to some of the mysteries of higher mathematics, to Euclid and to the wonders of astronomy by his new-found friends, Samuel Holland and Joseph DesBarres.

In Fort Needham Park at Halifax there stands today a memorial plaque bearing this inscription:

"JAMES COOK, AS MASTER OF H.M.S. PEMBROKE AND H.M.S. NORTHUMBERLAND SPENT THE WINTER MONTHS OF 1758-1762 IN HALIFAX, COMPILING CHARTS OF THE ST. LAWRENCE AND DESCRIPTIONS OF THE COAST OF NOVA SCOTIA FROM PREVIOUS CHARTS AND HIS OWN OBSERVATIONS, AND IMPROVING THAT KNOWLEDGE OF MATHEMATICS AND SURVEYING WHICH HE PUT TO SUCH GOOD USE LATER IN NEWFOUNDLAND AND THE SOUTH PACIFIC".

And it might be added, on the coast of British Columbia.

1

EARLY MAN DRAWS HIS PATHS AND BOUNDARIES

Cartography has no definite point of beginning in history; its roots are deep in a wide range of human activities. One could as easily trace the art of mapping to its origin as discover and identify the first wheel made by man. These are happenings lost forever in the mists of antiquity. But some of the basic elements of map-drawing, such as graphic representations of paths leading to game haunts, to oases or to salt-licks, were present in the earliest sketchings of primitive peoples. These crude portrayals first appeared on the walls of caves, on dried animal skins, on desert sands and on Arctic snows. Mapping and man's mobility have progressed together. Indeed, a map that serves its purpose speaks a universal language, is timeless and transcends all human barriers.

There is an ancient clay tablet in existence today that bears a map of part of what is now known as northern Mesopotamia. The tablet was fashioned about 3800 B.C.[1] In Turin, Italy, there is a representation of Wadi Alaika in Africa, an area in which Nubian gold mines were then in operation. This map, according to experts, dates back to 1370 B.C. As a sample of early cartography it is of special significance because it demonstrates that even at this early stage in man's story, mapping was closely linked with the development of natural resources.

On their Pacific islands native Tahitians constructed relief maps out of wood. Aborigines of the Marshall Islands sought to make crude charts out of bamboo material. Primitive peoples generally seem to have possessed the instinctive ability to produce quite accurate, if somewhat rough, sketches on sand or bits of skin in order to guide themselves on their ambitious journeys.[2]

The first reference to a map in the writings of the Hellenic world is to be found in Herodotus.[3] Anaximander is credited with the production of the first Greek map. It made its appearance early in the sixth century before the birth of Christ. But for the most part we of the twentieth century must only imagine what early maps looked like. It is certain that such productions suffered from a very high rate of destruction. Sand

and snow do not lend themselves to the perpetuation of lines drawn across their shifting surfaces. On vessels at sea, when navigation was young, maps were highly expendable items. Fires and floods, as well as shipwrecks, contributed greatly to the mortality of maps. Metal globes fared little better. A hollow metal globe cut more or less neatly in half would produce serviceable camp pots for bandits or for invading soldiers. In addition, large maps were very awkward to store and folding them only hastened deterioration.

But it was in Egypt, under the Pharaohs, that ancient mapping entered a period of marked development. Up until that time the practice of cartography had grown very gradually. Now a fairly exact science was to blossom out of what had been a rather crude form of art. Some early Egyptian maps were murals only but maps and plans have been discovered on papyrus rolls. The concept of maps as instructions helpful to travellers had an early portrayal in the maps of the nether regions inserted in coffins.

In the quarter century preceding the birth of Christ, Egypt and the teeming city of Alexandria near the great Nile's mouth, provided an environment favoring the exercise of the human intellect. The climate was salubrious and the spirit of the place stimulating. Alexandria not only spurred the ambitious to excel in scholarship and research, it encouraged creativity of scientific thought.

Egyptians enjoyed, in these fields, a rich heritage from the distant past. An amazingly extensive and relatively accurate catalogue of star movements over a period of centuries had been compiled and preserved by Babylonian priests. All modern surveyors and cartographers owe much to that unknown person who first uncovered the mighty, though paradoxical fact of nature that in order to best find one's location on this earth, one must first scan the starry heavens. From Babylonia, it is now thought, came the idea of devising the separation of the eclyptic into twelve signs and later into 360 degrees with the further refinements of 60 minutes and 60 seconds of subdivision, as well as the division of the day into 24 hours. When the Greeks and Egyptians adopted these concepts, mapping entered the category of a science.

As man, in those far-off times, pondered the night skies, it came to be realized, at least by the elite, that the stars as well as the sun re-appeared in the east after apparently setting in the west. Up until this revelation the idea had been prevalent that the earth was a disk suspended between heaven and hell. The Greeks liked to believe that Atlas braced the pillars supporting the heavens. But gradually it dawned upon the more discerning that the world was, in fact, isolated in space. Yet it was not until Aristotle, the founder of theoretical geography, that the concept of a spherical world was proposed with some confidence. There were the persuasive arguments, impressive enough to the ancient Greeks and familiar to moderns, of ships that slowly slipped beneath far horizons, their masts being the last of the vessels' parts to disappear from sight; of the circular shadow of the earth on the moon in eclipse as well as the differing appearance of heavenly bodies as witnessed by anyone travelling from point to point on the earth's surface.

Among the Greeks attracted to Alexandria about 25 B.C. was a young man named Strabo (born 63 B.C.) who was destined to exercise a profound influence on the science of cartography and to occupy a high place among the eminent geographers of all time. He was well educated, partly in Rome, before coming to Egypt. He had travelled over much of the ancient world of Europe and Africa. Although it is uncertain whether Strabo ever compiled a map of his own, he did write a *Geography* which was the first manuscript of its kind to survive to our times. It is therefore the key to the foundation of modern cartography.

Just as Champlain, in his surveys and mapping expeditions in Canada, was materially aided by the heritage of knowledge and experience bequeathed by the searching minds of earlier centuries, so did Strabo benefit from the pioneers in astronomy and navigation who had preceded him.

Even before the time of Strabo the Phoenicians of the eastern Mediterranean had become accustomed to sailing their ships on occasion out of sight of land and at night. Without compasses, how did they accomplish this? The answer seems to be in their natural skill and some training in the uses of astronomy and arithmetic. The Phoenicians knew their stars and how to steer by them. Quite likely they possessed crudely drawn charts and written sailing directions of a sort. They developed a type of wind-rose on their charts. This was a circular design containing points in various directions bearing names of the winds and the quarters from which they blew. But it was not until the eighth century A.D. that the idea was accepted of limiting the number of points to 32 on the wind-rose card, based on the north, south, east and west winds, supplemented by quarter- and half-winds.

The oldest existing example of sailing directions for navigational purposes is Stadiasmus, a kind of Cook's Tour guidebook of ports of the Mediterranean and Black Seas, written by one Scylax of Caryanda several centuries prior to Christ's birth. The text is no masterpiece of literary art but it was remarkably comprehensive in its scope, indicating among other things the sailing times between ports. If this text was written to accompany a chart then no such chart has yet been discovered. Sailing directions may be said to be the lineal predecessors of marine charts. Stadiasmus, if compiled in the 4th or 5th centuries B.C., forms the final Greek contribution of this nature to the art of navigation.[4]

In his *Geography* Strabo endeavored to put the known world of his day in its setting within the entire universe, including the movements of stars and planets as well as the nature of the earth itself. He stressed the importance to geography of astronomy and geometry. Once again we find this awareness of the fact that in order to locate himself in his world, man should first study the heavens and master their awesome secrets. Astronomy was indeed to become the handmaiden of surveying and cartography and Strabo was one of the first to realize this fundamental relationship. He realized as well the value of the priestly records of Babylonian star-lore related to the task of mapping the earth.

What were some of the questions challenging the curiosity of scientists in Strabo's day? Greek and Egyptian scholars pondered over a number of insistent queries. What is the true shape of the world? How big is the world? Does it move or is it stationary? Homer's idea was that the world was composed of a flat disk entirely surrounded by water, "washed by the oceans" for no matter in what direction man travelled in the ancient world he finally ecountered the apparently endless seas. And for those early Greek philosophers the skies were held in place by a series of invisible pillars, braced by the muscular god Atlas.

About 500 B.C. Pythagoras the Greek suggested that the earth might not be flat after all, but spherical. Aristotle was convinced of the validity of this hypothesis. He had a firm supporter in another distinguished Greek thinker. He was one who, to an important extent, paved the way for Strabo, his fellow-countryman. The name of this pioneer was Eratosthenes of Cyrene (276 B.C.-196 B.C.) who became head of the Alexandrian Library. He, too, was convinced that the earth was spherical and he became the first person to work out a sound method of measuring the earth's size. In this respect Eratosthenes made a basically significant contribution to the sciences of cartography and surveying because once the fact of spherical form was accepted, astronomers were able to establish lines of latitude on the earth's surface.

How then did the learned and ingenious Greek scientist go about the solving of this problem, so formidable in his day, of measuring the size of the earth? To begin with he was aware of certain basic facts. He believed that the distance between Alexandria and Syene, Egyptian cities located on a north-south line, was 500 miles. Actually that distance was 453 miles. He had heard from citizens of both cities that the sun reached its meridian, highest point in the sky, at the same time of day in both places. He knew that at Syene when the sun came as far north in summer as it would come, it was directly overhead at mid-day and sundials at Syene on that particular day did not cast shadows.

But Eratosthenes also knew that in Alexandria the situation was not just the same as in Syene. Instead of being directly overhead at the peak of the summer solstice the sun, shining over a pole stuck in the ground, cast a shadow equal to one-fiftieth part of a circle.

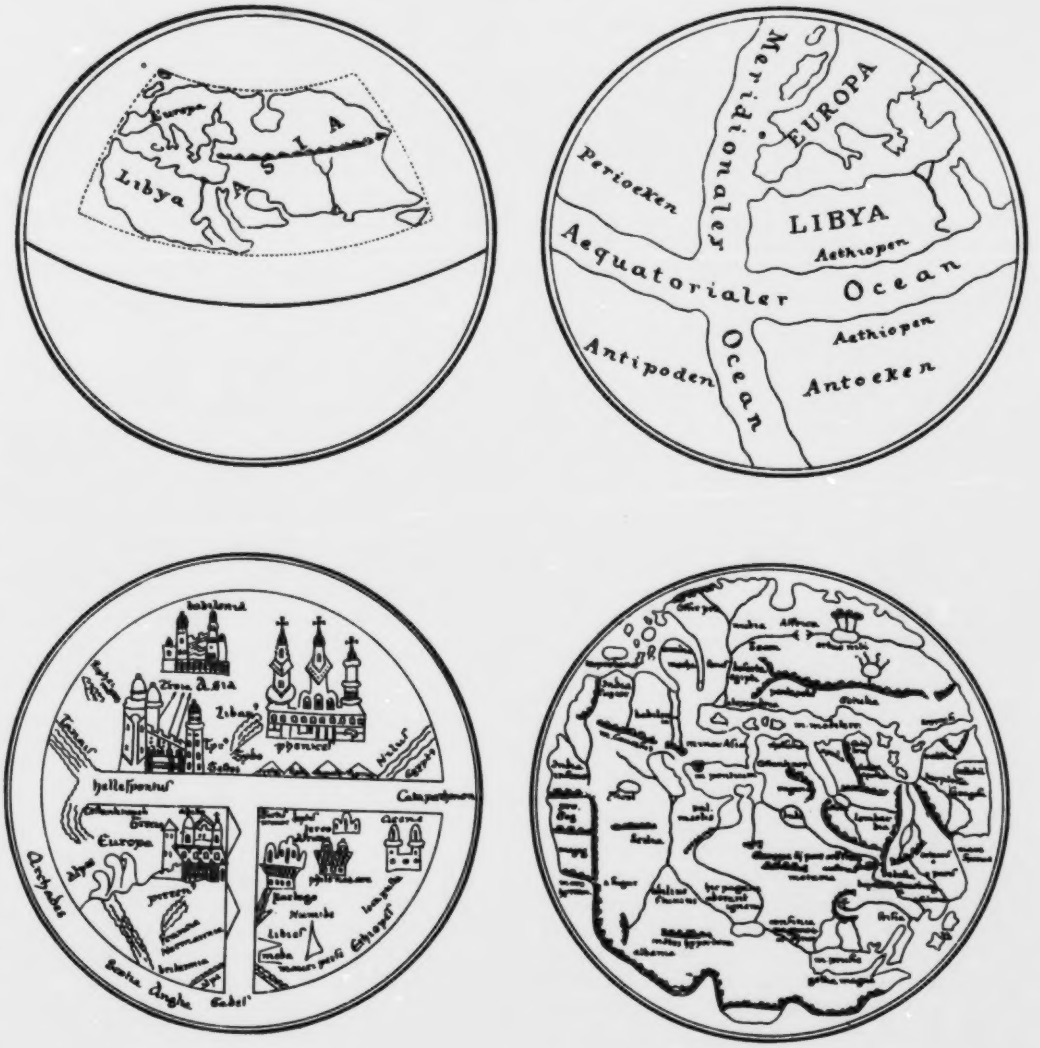
Those were the fundamental facts, then, on which Eratosthenes theorized that the distance (as he thought) between Alexandria and Syene being 500 miles, this distance was equal to one-fiftieth of the circumference of the spherical earth. Thus the linear distance of the earth's circumference would be 25,000 miles or in terms of the units of length which he used, 225,000 stadia or 24,662 miles. The actual figure is 24,899 miles.

Obviously Eratosthenes did not realize at the time of his historic measurement that the earth was not a perfect sphere. From his calculations, and on the basis of the earth being divided evenly into 360 degrees, each degree would then be equivalent to 68.5 miles. As matters turned out this quite accurate figure was not respected in subsequent times. This failure to accept the finding of Eratosthenes had the effect of slowing up the growth of cartography generally. But his was the first attempt to ascertain the earth's true size by measuring the arc of a meridian. In nearly every respect this method was the one later to be used for this purpose even into modern times. The measurement of Eratosthenes, having regard to the unavailability then of telescope or of any precision instrument, is truly remarkable. It was a phenomenal achievement in the advancement of both surveying and mapping.

Strabo, for his part, did the science of cartography a signal disservice when he did not accept Eratosthenes' theory but used another calculation of 18,000 miles[5] as the distance around the earth at the equator and 50 miles as the distance of one degree of arc. These two conclusions were to bedevil geographers for a long time to come.

The use of a stake inserted in the ground led to the fixing of the first three parallels of latitude on a map. It was the ratio of shadow to the height of the stake which determined these basic decisions. On the day when no shadow was cast by the stake situated on the equinoctial line because the sun was directly overhead, that line became the equator as well. This served to divide (theoretically) the earth into northern and southern hemispheres. This was a kind of astronomical base line, the first to be established. The second and third parallels of latitude were, of course, based upon the line of the equator. To the ancients these were the summer and winter Tropics, marking the extremes in the sun's upward (to them) course and its downward limit. The summer Tropic in time became the Tropic of Cancer, or crab, and the southern or winter Tropic that of the he-goat or Capricorn. Cartographers were thus provided with the first east-west parallel lines that could be set down on a map.

Eratosthenes defined "meridian" as a circle passing through the poles of a spherical earth and at right angles to the horizon. The equatorial line was one midway between


Europa
A S I A
Libya
Meridionaler
EUROPA
Perioeken
LIBYA
Aethiopen
Aequatorialer
Ocean
Ocean
Aethiopen
Antipoden
Antoeken
hellespontus
Europa
phenice

MAP 1. Circular maps from earliest pre-Ptolemaic times to the late Renaissance period.

the two poles of the earth's axis and in a plane at right angles to it, the line where day and night were of equal lengths.

The learned Greek laid down a map of the inhabited world and claimed that its length from ocean to ocean was 7,800 miles. The remainder was sea. His north-south lines were not laid down in any methodical or orderly fashion. He placed them where convenient or where the spirit moved him to put them, nine of them in all. Apart from the irregularity of the Eratosthenes map grid, his network of parallels and meridians, his production was, in the main, approved by Strabo. He explained to critics of the map that it was drawn without the aid of such instruments as stakes or sundials. But like most early maps the result was a curious combination of folklore, philosophy and fact.

One of the critics of Eratosthenes was Hipparchus who made one influential suggestion concerning the construction of a series of lines at right angles to the parallels, to be determined astronomically, with great circles passing through the poles (lines of longitude) equally spaced and thus forming an orderly, geometrical pattern of the surface of the whole world. This dream of Hipparchus about establishing lines of longitude was destined to remain a vision until the invention of an instrument that would accurately mark the passage of time, even on a storm-tossed sea. Hipparchus and, some 300 years later, Claudius Ptolemy, laid down the basis for trigonometry, compiling mathematical tables of considerable durability.

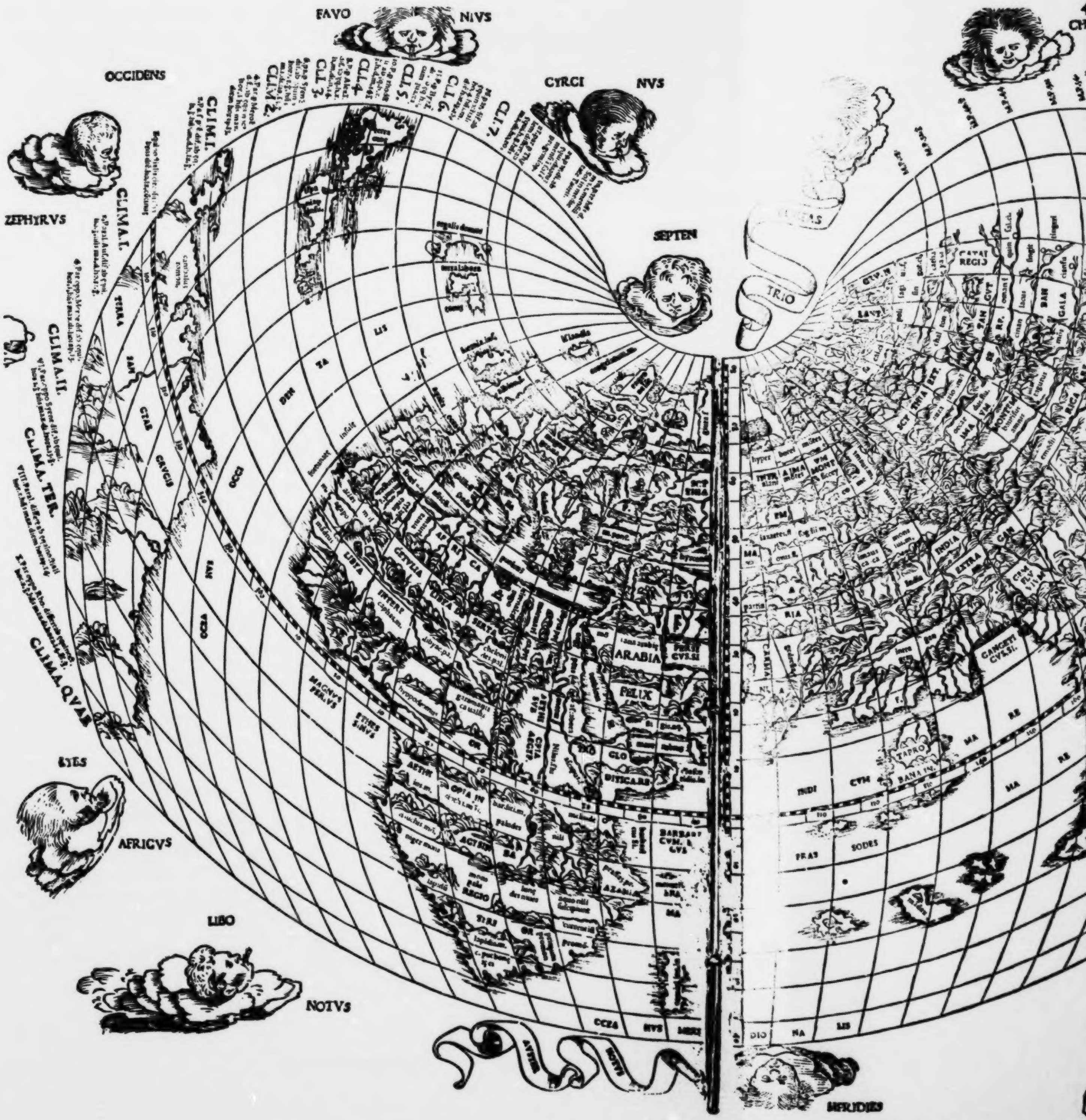
Strabo foresaw the problem of map transposition, from globe to flat surface, a problem met for most practical purposes by Mercator and his projection plan, a development to come more than 1,500 years later. As Lloyd A. Brown points out in his book "The Story of Maps" the publication of Strabo's *Geography* took place within the first 20 years of the Christian era and brought to a climax the initial period in the history of cartography prosecuted on a scientific basis.

The age of Strabo was followed by the age of Ptolemy. Claudius Ptolemy is, in many ways, a mysterious figure in cartographic history. Little is known about him as a man, about his origins or the details of his highly useful career. Probably Ptolemy's greatest works were his *Geographia* and his *Almagest*. The latter contained his theories on map-making. Ptolemy's principle was to repeat observations many times in order to reduce chances of human error, a principle faithfully followed by scientists today. He conceived the primary function of geography to be map making and indicated that the task of the cartographer was to survey the entire world to scale. He believed that mathematics and celestial observations were the principal tools of the map maker.

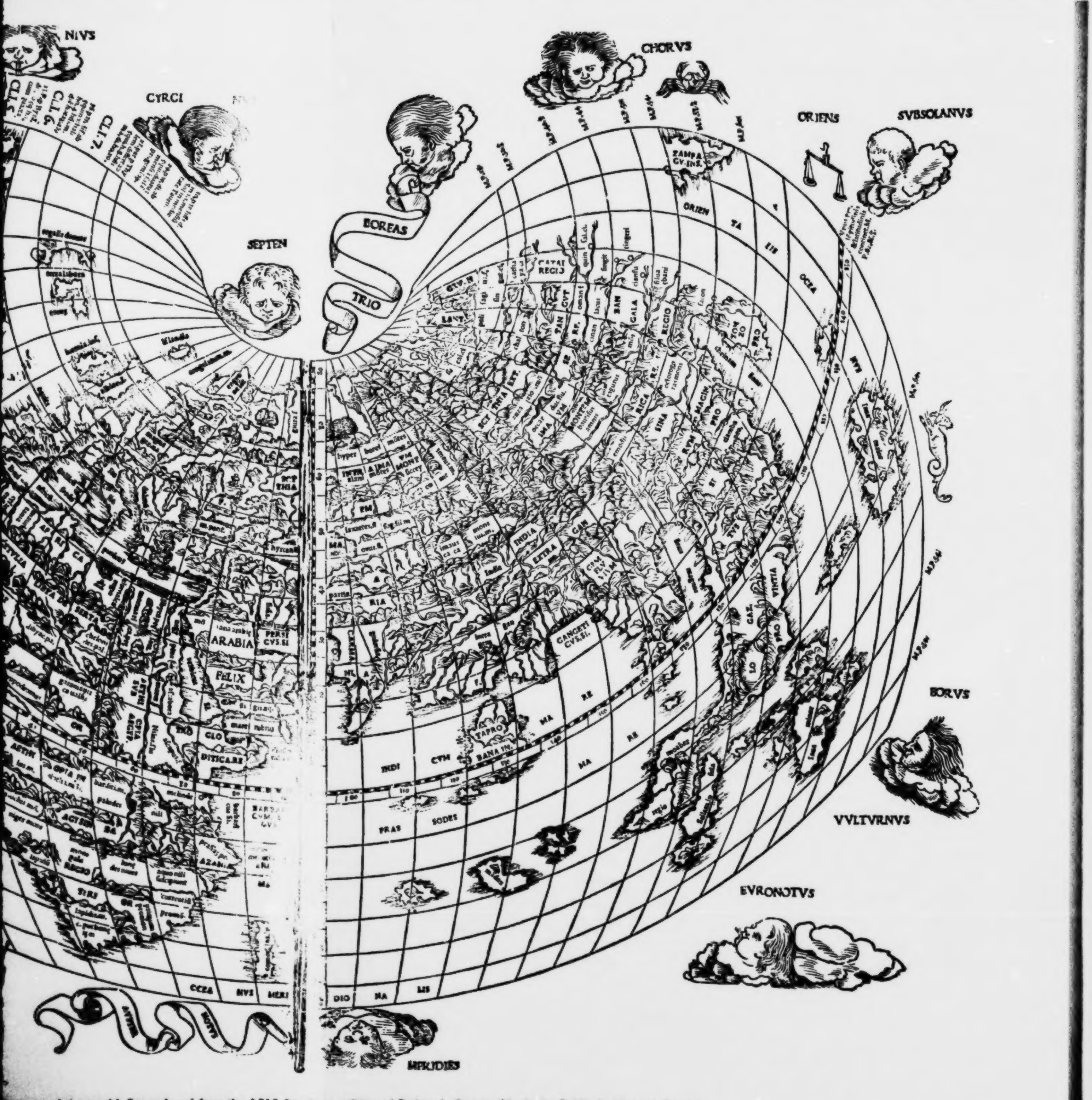
In Book 8 of his *Geographia* or Atlas of the World, Ptolemy states: "It remains for us to show how we set down all places, so that when we divide one map into several maps we may be able accurately to locate all of the well-known places through the employment of easily understood and exact measurements."

Ptolemy was concerned about the importance of drawing maps to scale, to maintain proper proportions. In his 27 maps accompanying the text of the *Geographia,* Ptolemy made 10 of Europe, 4 of Africa, 12 of Asia and one general map of the world. He included tables of distances with his maps. Nobody can be absolutely certain whether Ptolemy drew these maps himself or whether someone else actually performed the work. Whoever is responsible for the handiwork was the first to employ hachuring and various colors.

Ptolemy chose to follow the erroneous conclusions of Strabo rather than the more correct deductions of Eratosthenes on the estimated linear length of the earth's circumference and, correspondingly, the value of each degree. His value of a degree was only 56½ miles. One result of following this false lead is that Ptolemy's equator is 400


FAVO NIVS
OCCIDENS
CYRCI NVS
ZEPHYRVS
SEPTEN
TRIO
CLIMA.I.
CLIMA.II.
CLIMA.TER.
CLIMA.QVAR.
EVRVS
AFRICVS
LIBO
NOTVS
MERIDIES
ARABIA
FELIX
LIBYA
INDIA
EXTRA
GANGETICVS SI.
TAPROBANA
BARBARICVS SI.
MAGNVS PERIVS

MAP 2. Ptolemaic map of the world. Reproduced from the 1513 Strasburg edition of Ptolemy's Geographia. In the Public Archives


NIVS
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ORIENS
SVBSOLANVS
SEPTEN
BOREAS
TRIO
CATAI REGIO
ARABIA
FELIX
GANGETICVS SI.
TAPROBANA
INDI
MA
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EVRVS
VVLTVRNVS
EVRONOTVS
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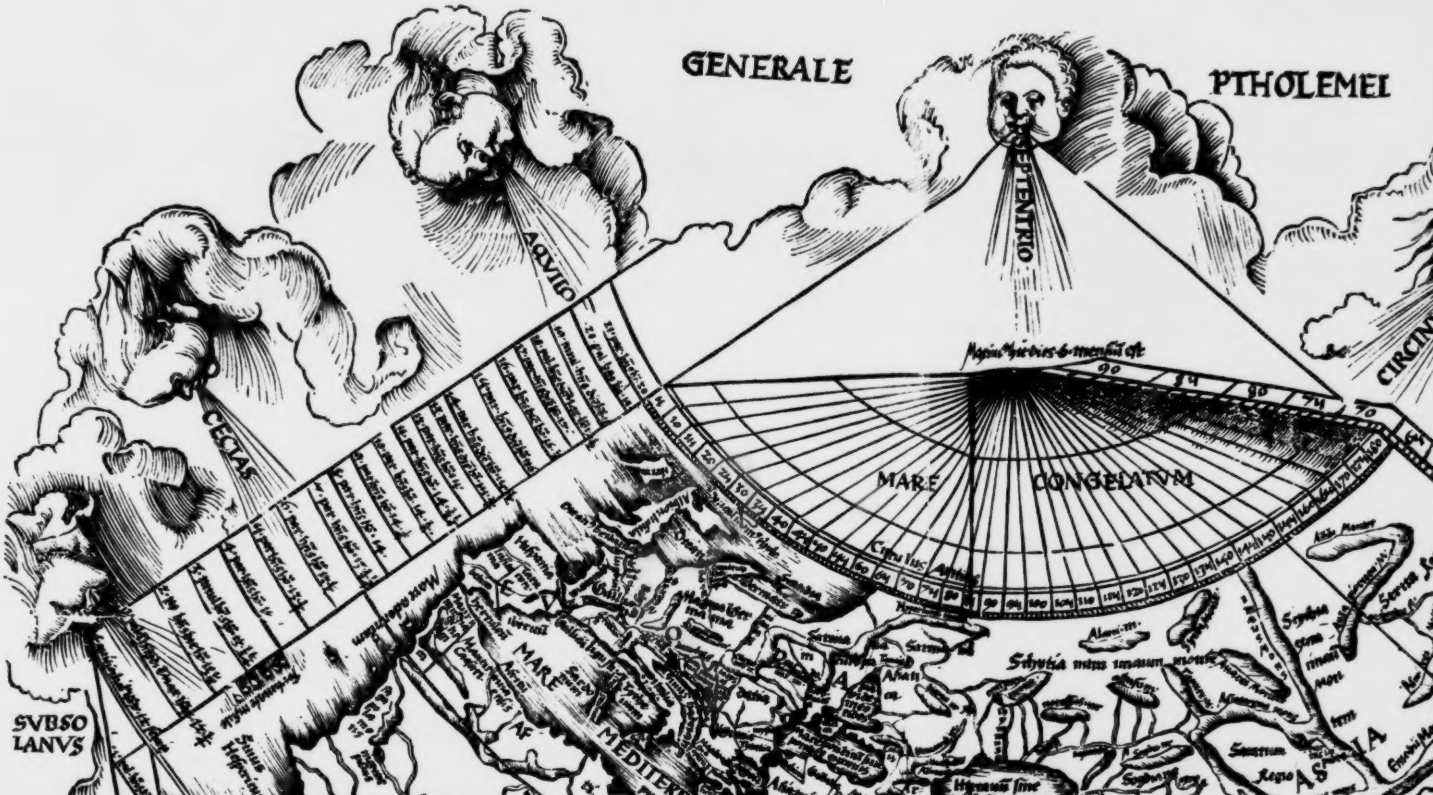
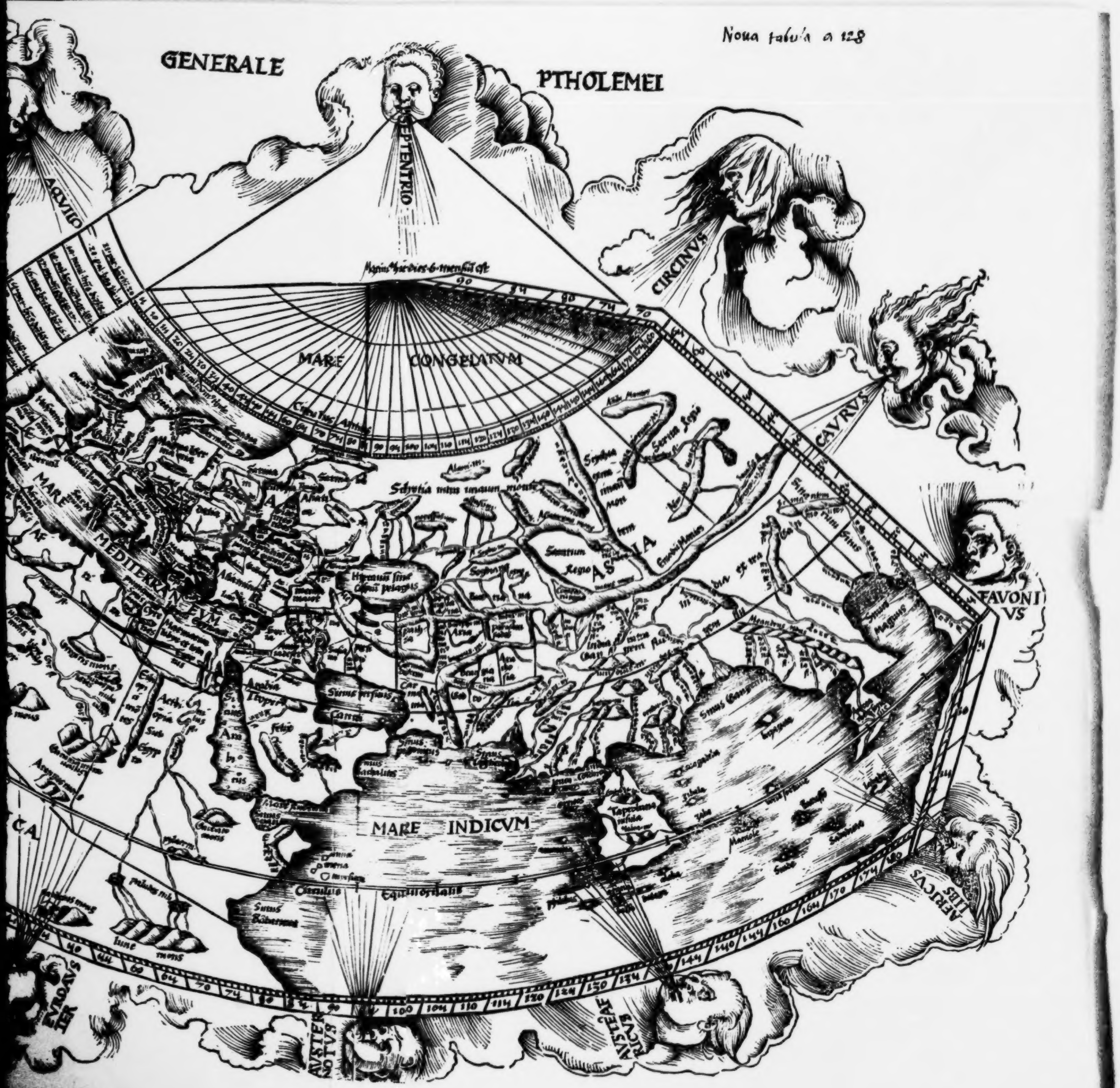
e map of the world. Reproduced from the 1513 Strasburg edition of Ptolemy's Geographia. In the Public Archives of Canada.


GENERALE
PTHOLEMEI
AQVILO
PTENTRIO
CIRCIN
CECIAS
SVBSOLANVS
EVRVS
EVROAVS TER
AVSTER NOTVS
AVSTERAF
MARE CONGELATVM
MARE MEDITERRANEVM
AFRICA
Libya
Aethiopia interior
Thalis mons
lune mons
MARE INDICVM
Equinoctialis
Sinus Barbaricus
Scythia intra imaum montem
Arabia felix
AS IA

MAP 3. Cordiform map of the world. Reproduced from Sylvanus' edition of Ptolemy, Venice, 1511. In the Public Archive


Noua tabula a 128
GENERALE
PTHOLEMEI
SEPTENTRIO
AQVILO
CIRCINVS
CAVRVS
FAVONI VS
AFRICVS LIBS
AVSTER AFRICVS
AVSTER NOTVS
EVRO AVSTER
MARE CONGELATVM
MARE MEDITERRANEVM
ASIA
MARE INDICVM
Sinus persicus
Hyrcanum siue Caspium pelagus
Sinus Gangeticus
Taprobana insula
Equinoctialis
Sinus Ethiopicus
lune mons
Scythia intra imaum montem
Scythia extra imaum montem
Serica regio
Sinarum Regio
Arabia felix
India intra Gangem fluvium
India extra Gangem fluvium
Sinus Magnus

2. Cordiform map of the world. Reproduced from Sylvanus' edition of Ptolemy, Venice, 1511. In the Public Archives of Canada.

miles too far north of the actual. He laid down his principal or prime meridian through the Fortunate Isles (the Canaries or the Madeira group). His factual meridians were calculated and fixed westward from Alexandria. His Mediterranean was many degrees too long and its width was also too great. His Indian Ocean was portrayed as a landlocked sea.

With all its faults, the outcome of a none-too-surprising lack of authentic information, Ptolemy's towering work proved to be cartography's most helpful and most spectacular beacon of knowledge and guidance for more than 14 centuries. Without this prodigious intellectual achievement the progress of western civilization would have been profoundly slower. It was on Ptolemy's achievements that Christopher Columbus based his ambitions and, for better or for worse, revealed not quite in accordance with his expectations, a New World to mankind.

Thus, even in the years immediately following the birth of Christ, scholars and scientists of the ancient world were altering man's concepts of the earth and the universe as well as suggesting more precise methods of fixing positions on the earth's surface. A fairly accurate estimate had been made of the length of the earth's circumference and therefore of the value of each of the 360 degrees of that circumference. The Greeks had made an initial attack on the projection problem involved in transposing the surface of a sphere to the surface of a flat paper. There had been a bold attempt to set up a more or less rigid framework of latitudes and longitudes for a world map. A table of latitudes had been compiled by the Greek astronomer, Hipparchus. The difficulty over fixing meridians, the north-south lines of a map in proper and uniform spacing, was to remain unsolved for centuries to come. Without the aid of the magnetic compass it was impossible to determine the bearing of one place in relation to another.

Whether Ptolemy himself did or did not draw the famous maps bearing his name, a wealth of topographic detail was transmitted to the leaders of Renaissance activity in map making and profoundly influenced their cartographic ideas and practices.

2

THE ROMANS AND RECTANGULAR LAND SURVEYS

As early as three thousand years ago a rectangular system of dividing land was in use in China. In the course of several more centuries a similar system appeared in Italy under the Romans. For purposes of colonization the land was divided into squares, each called a *centuria.* Land so divided was described as *agro centuriato,* land divided into hundreds. The traces left today in Northern Italy represent the oldest surviving form of land survey in the Western World.

Clues to the existence of a rectangular system of survey under the Romans are to be found in the road and canal patterns seen between the Po Valley and Rome, as well as in the shape of farm holdings in that region. But it was not until fairly recent times that these arrangements were recognized as the product of surveys of the classical period.

Although existing traces of the system in Italy are the oldest to survive in the Western World, it is generally accepted by historians in this field that the first definite identification of a rectangular survey of Roman origin was at Carthage in North Africa. After the fall of that city in 140 B.C. the Romans introduced a land survey *divisio et assignato;* boundary markers used in it have been uncovered in recent times. In fact the *lex Livia,* the law pertaining to the disposition of Carthaginian territory, provided that it should be surveyed and divided according to the *centuria,* a unit containing 100 heridia. It was 2,400 feet square or 132 acres. This Roman survey unit may be compared to the present Canadian and U.S. unit of the township consisting of 23,000 acres.

The first step in a Roman survey was the selection of a central point, a point of beginning, called *umbilicus.* This was to be the intersection of the principal coordinates. In addition to the point of origin, other features of the Roman system of special interest consisted of a principal meridian or *cardo maximus* and a base line or *decumanus maximus.*[1] As in the realm of mapping, it is quite impossible to trace the invention of the rectangular survey system to any individual of ancient times.

The first lines laid out by Roman surveyors, therefore, were the *decumanus* and

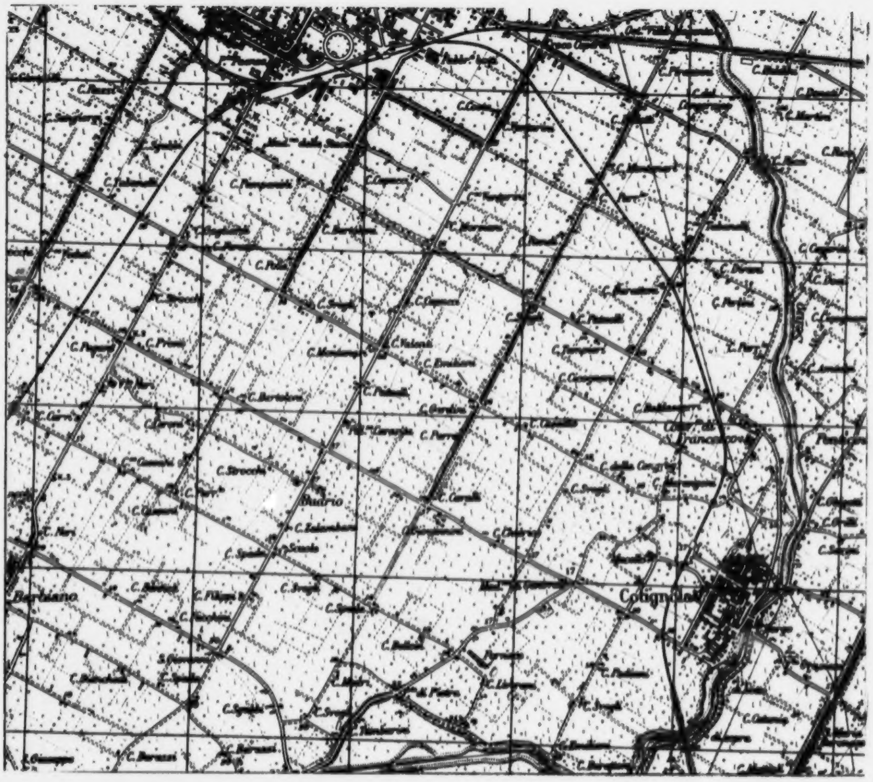


FIGURE 2. Remnants of the Roman survey south of Lugo, Italy. From the *Cotignola* sheet.

the principal coordinate running at right angles to it, the *cardo*. Law and custom regulated the width of roads which commonly formed initial survey lines. Usually these were 40 feet wide. The law of those days provided that all of the principal roads forming part of the survey grid should be declared public thoroughfares. Roman law also required that corners of a *centuria* be clearly marked. On one of the Roman boundary markers found in modern times in North Africa was the inscription that the survey had been executed by the Third Legion "Augusta" in 29-30 A.D.[2]

The actual division of the land was known as *forma* and the surveyor's rough field notes as *commentarii*. In their more permanent form, whether on bronze, marble or wood, these notes were known as *typus* or *pertica*. Apparently one copy of the notes and of any accompanying sketch or sketches were deposited in a local archives as well as in the central archives or tabularium in Rome.[3]

The surveyor's craft was founded by Julius Caesar, according to writings of land measurers of the Roman Empire. Cicero refers to Saxa as an expert surveyor, a *peritus metator*. After 70 A.D. surveyors became state employees. A department or office of surveyors was headed by a chief, *primicerius mensorum*. Applicants for posts as surveyors were required to pass examinations and, if successful, to be formally accepted

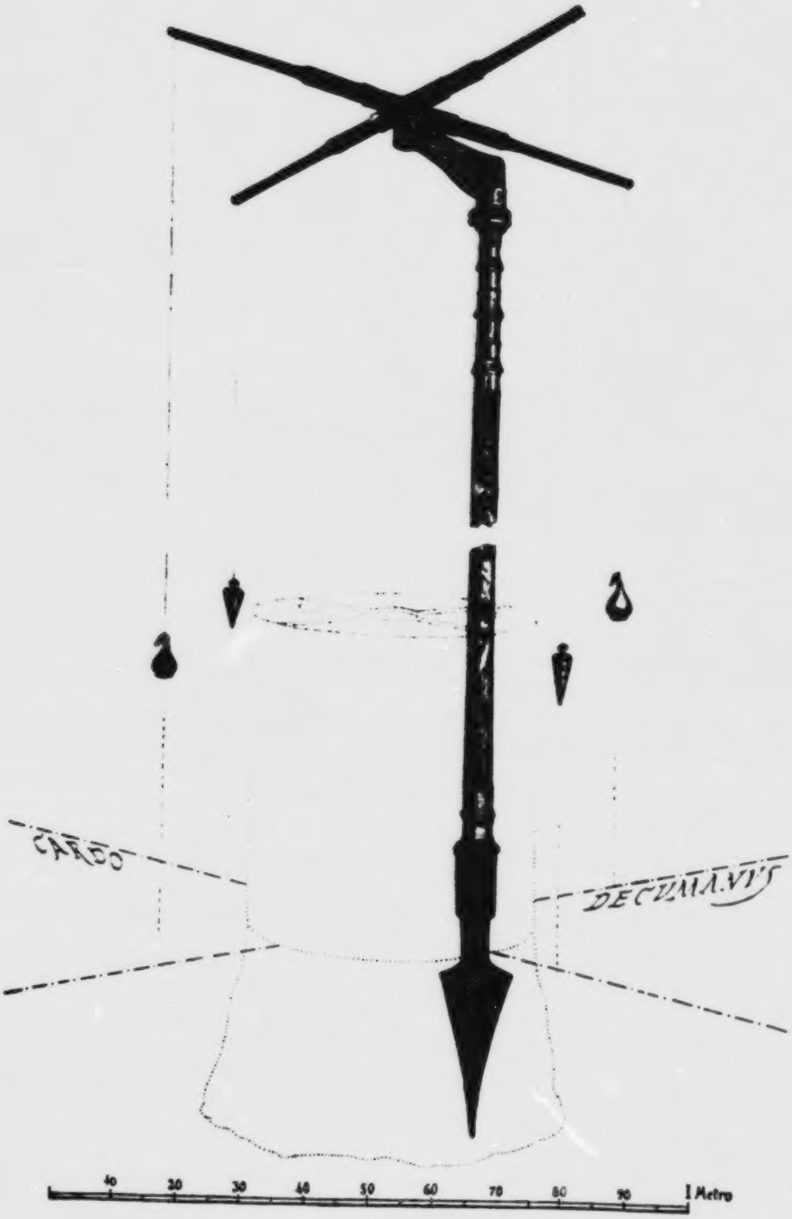

CARDO
DECVMANVS
10
20
30
40
50
60
70
80
90
1 Metro

FIGURE 3. Reconstruction of Roman surveyor's instrument, the *groma*, from parts found in Pompeii. Two pairs of plumb lines are suspended from two horizontal rods set at right angles to each other.

for membership in the craft. These successful ones were known as *mensores*, *agrimensores* or *gromatici*. The latter title arose from the most important instrument then used by surveyors, the *groma*. The *groma* was employed in the field in much the same manner as a transit. In 1912 a complete *groma* was discovered in Pompeii, in the house of a surveyor named Verus.

The chief interest for Canadians in the Roman surveys lies in the reflection that more than twenty centuries ago, a system of surveying land in rectangular blocks was in effect in Europe and Africa and that its influence persists today, particularly in our prairie provinces. In a very real sense the vast Canadian land measurements stand with those of many of the states of the United States as a New World tribute to the achievements of surveyors of Roman times.

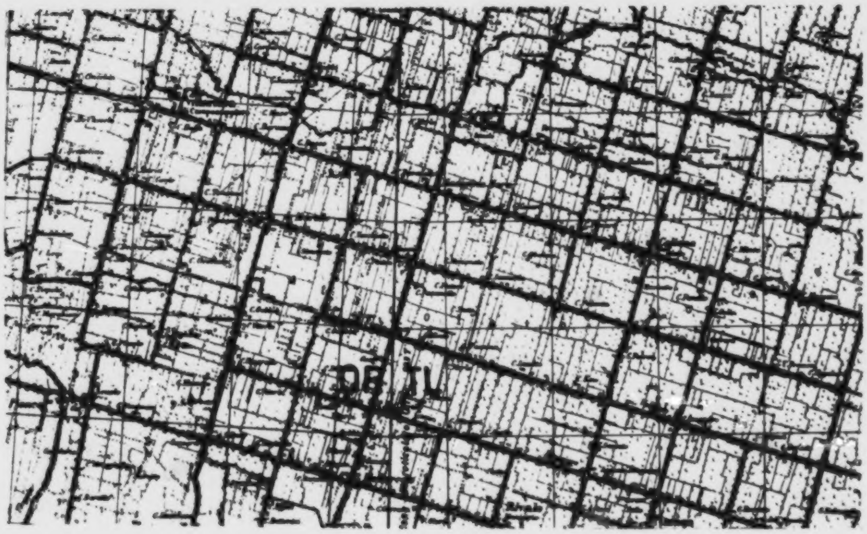


FIGURE 4. The Roman survey grid northeast of Padua, Italy. From the *Dolo* sheet. The words *graticolato Romano* (Roman grid) appear on this map.

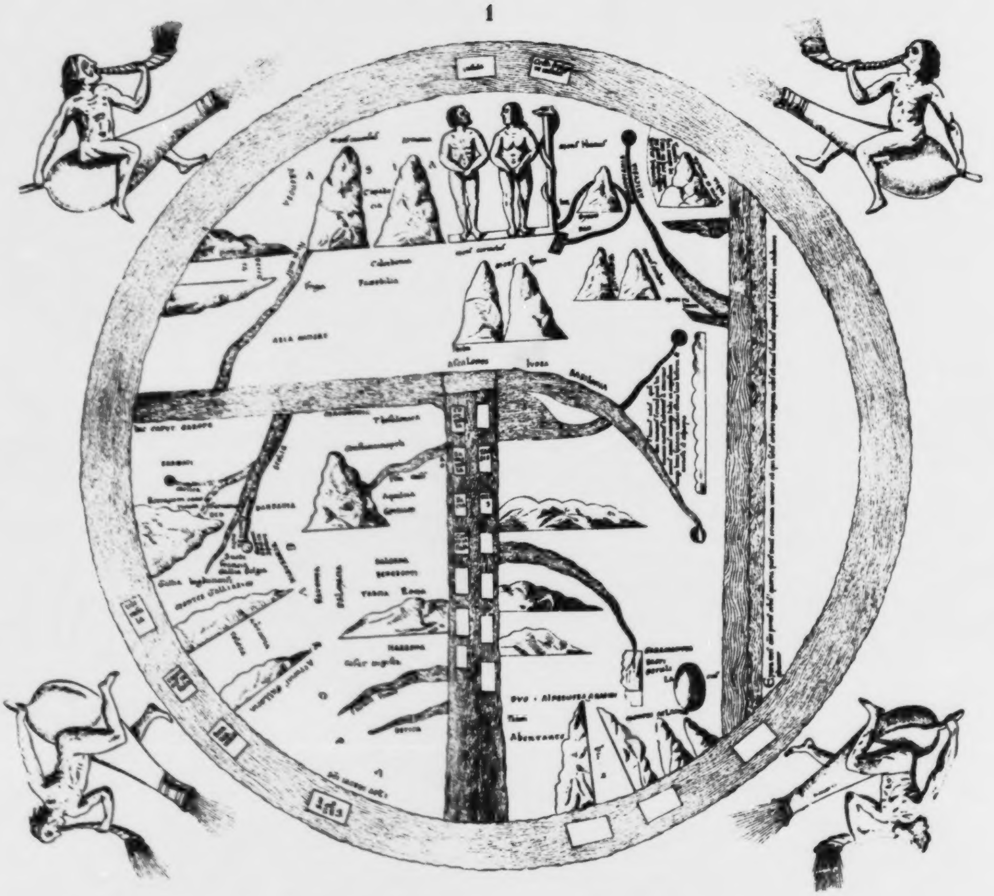
3

MAPPING IN THE MIDDLE AGES

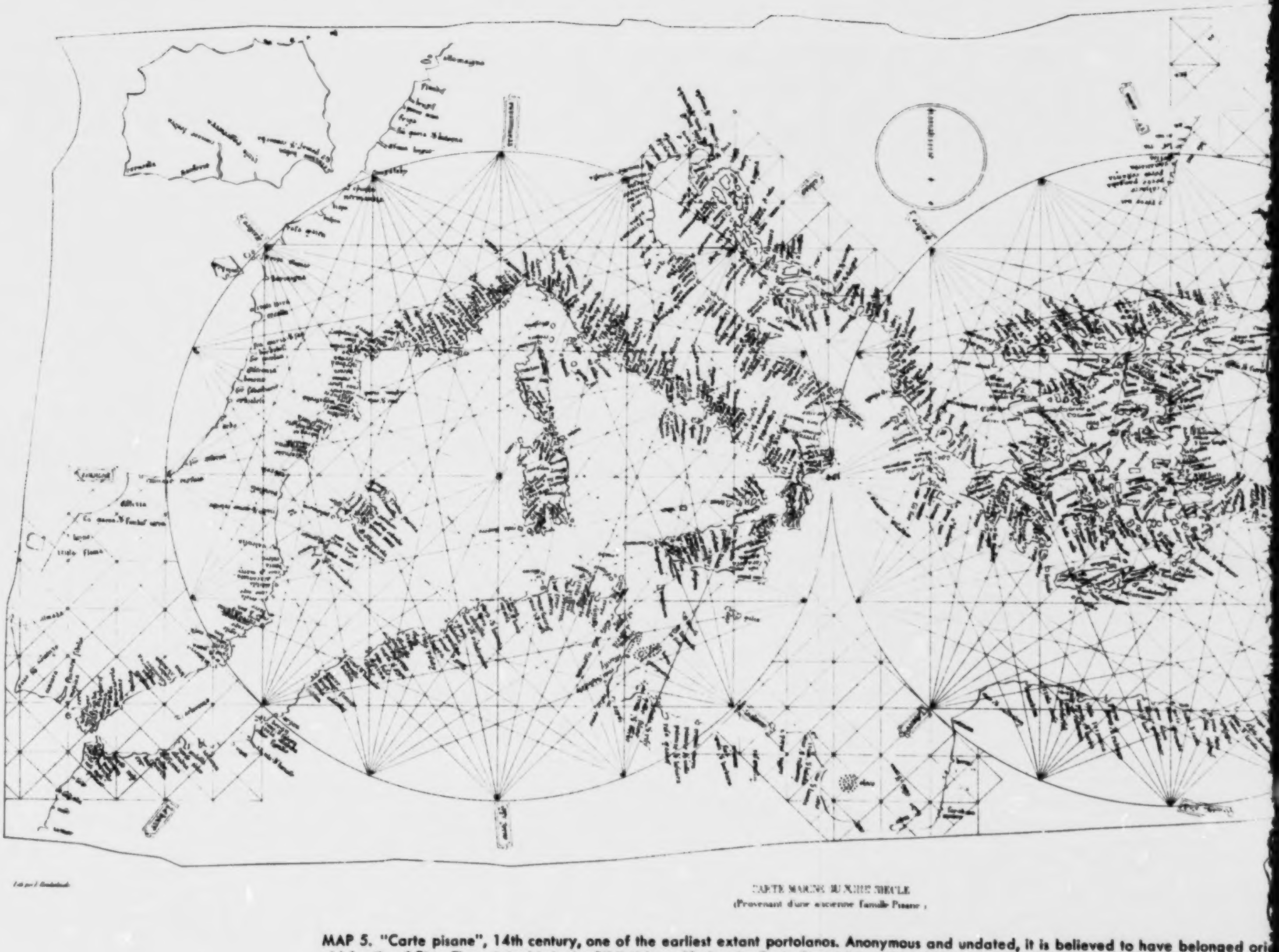
Although the Romans helped greatly to lay the foundations of modern surveying, the part played by them in the improvement of navigation practices in ancient times was not a very large one. The Romans, in fact, were not particularly impressed by Greek accomplishments in the realm of cartography, especially on the theoretical side. There is in existence a road map of the Roman Empire but it is a map that may be unique rather than typical of Roman achievement in this field of activity. The map does provide details of distances between various points depicted thereon but is quite indifferent to the need for information on directions and on orientation generally.

But in literary records of military campaigns one finds references to the use of maps by the Romans. There are references as well to a map of the world, *Orbis Terrarum* by Agrippa, son-in-law of Emperor Augustus. This world map was constructed shortly before the birth of Christ and may well have supplied a model for cartographic efforts throughout the Middle Ages. In any event Roman maps had a much more practical application to daily travel needs than did any Greek cartography. Small T-O maps, popular in later Roman times, were much in evidence in the Middle Ages. These were circular in form, sometimes called "wheel maps" and were usually divided into three parts. This partitioning was accomplished by a vertical 'T' design within an 'O', the latter representing the boundary of the known world. The horizontal stroke of the 'T' indicated the meridian from the Don River to the Nile. The perpendicular of the 'T' represented the axis of the Mediterranean.

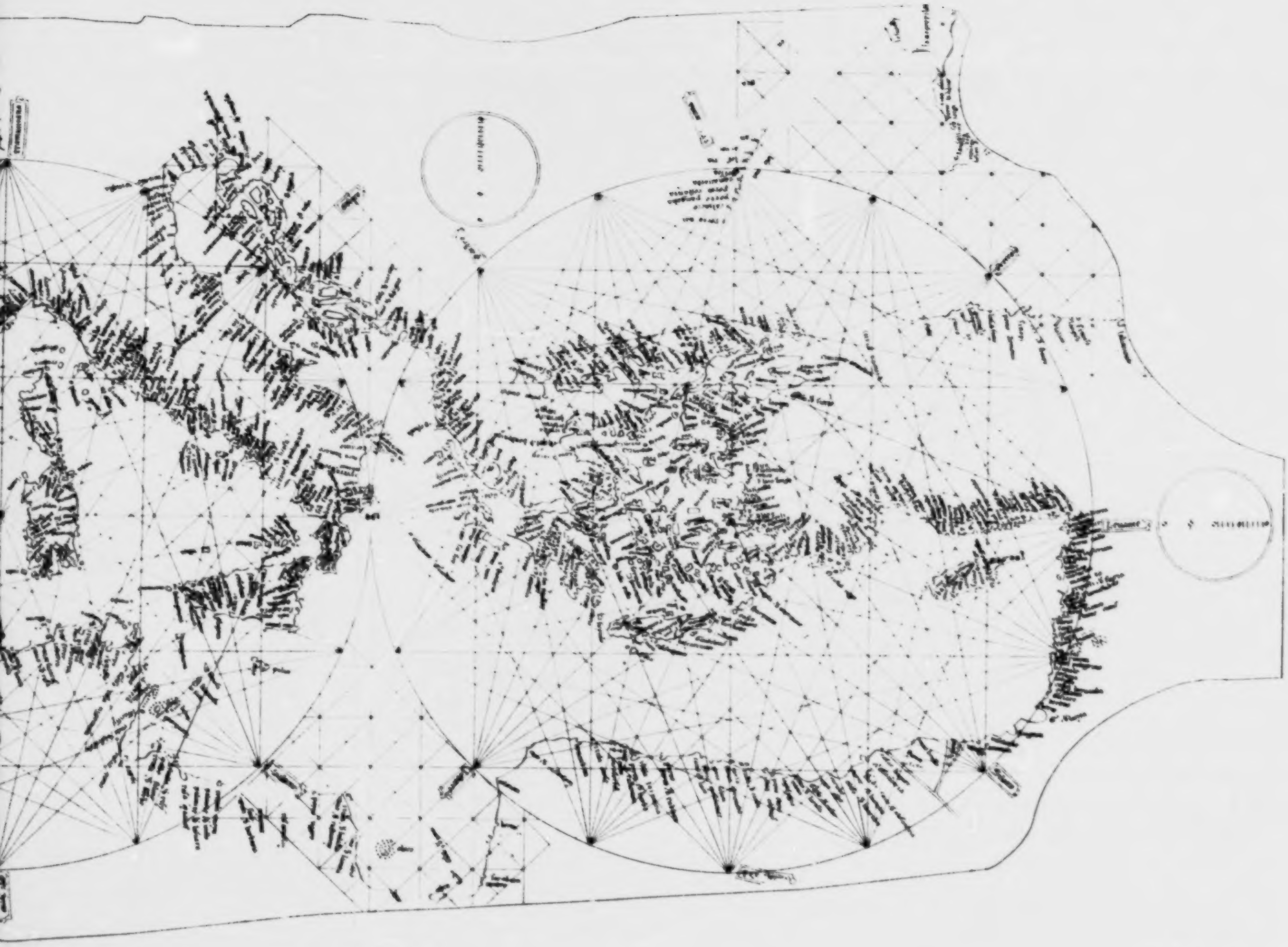
By 1300 scientific cartography was beginning to emerge from its hibernation during the Dark Ages. The expansion of knowledge, improvement in communications and the increasing desire for more information on the nature and dimensions of the world, spurred fresh interest and activity in both surveying and mapping. Marco Polo's adven-



MAP 4. "Turin" map of the twelfth century. This is the best known example of a strictly "dark-age" ("T-O") map. The original is in Biblioteca Reale, Turin. Reproduced from Giuseppe Ottino, *Mappamondo Di Torino*, Torino, 1892.


CARTE MARINE DU XIIIE SIECLE
(Provenant d'une ancienne famille Pisane.)

MAP 5. "Carte pisane", 14th century, one of the earliest extant portolanos. Anonymous and undated, it is believed to have belonged ori
old family of Pisa. The original is in the Bibliothèque Nationale, Paris. Reproduced from M. Jomard, *Les Monuments de la Géographie*, Pari



CARTE MARINE DU XIIIE SIECLE
(Provenant d'une ancienne famille Pisane)

4th century, one of the earliest extant portolanos. Anonymous and undated, it is believed to have belonged originally to an ginal is in the Bibliothèque Nationale, Paris. Reproduced from M. Jomard, *Les Monuments de la Géographie*, Paris, 1859.

tures in Cathay had their influence also in stirring up public curiosity and a spreading demand for facts concerning parts of the globe far away from the centres of European civilization.

One interesting innovation of medieval cartography was the introduction of color to maps as well as ornamentation, including human heads used as symbols of wind directions.

Following the break-up of the Roman Empire and during the greater part of the Middle Ages cartography certainly suffered from the church's intolerant and forbidding attitude towards the sciences generally. But Christianity in those uninformed, narrow-minded times was not completely unhelpful to the progress of mapping. The 'strange' doctrines of such pagans as Strabo and Ptolemy were frowned upon, it is true, by medieval Christian leaders but the multiplicity of Holy Land pilgrimages and military expeditions involved in the crusades (1096-1270) inspired the publication of travel guide books on an ever-expanding scale. As Brown states in *The Story of Maps* (p. 100): "To the majority of Christian worshippers the Crusades were a God-given opportunity to liberate the Holy Land from the power of the infidel. To the science of cartography they were the first step towards a permanent enlargement of the habitable world. The rumoured wealth of the Indies, Cathay and India became a known fact." The probing of Asia about 1300 and the resulting revelations had about the same explosive impact on Europeans as the discovery of America by Christopher Columbus two centuries later.

The general upheaval resulting from the Christian crusades did serve to shake the complacency and self-sufficiency of many Europeans and there was a consequent broadening of outlook and of thought. New lands, and new things had come to light and there had been the opportunity to see how other peoples lived, moved and had their being. The post-crusades European had learned to tolerate, to compare and to assess. He reacted favorably to fresh stimuli for scientific research. The disposition of Europe changed irretrievably after the crusades.

Prior to the discovery of America there were in Europe three broad categories of maps, namely, ptolemaic, ecclesiastical and portolan. In a general way it could be stated that these productions were respectively for the use of the scholar, the general public and for mariners. Our modern maps and charts have developed from the ptolemaic and the portolan types.

No true sea charts have survived to the present day from the first thousand years of the Christian era. So far as the history of surveying and mapping is concerned, the 14th century is noted for the widespread use of portolan charts and portolanos, some of which have been preserved for posterity. The portolan chart is a type of medieval map delineating coasts for the guidance of mariners. These charts appear to be closely linked with the expanding use of a brand new navigation instrument, the compass. Just how these charts were made remains a mystery. They were confined, in the main, to coasts of the Mediterranean and Black Seas. The term 'portolanos' applied not to charts nor anything in the nature of a map but referred rather to documents resembling what later came to be known as "sailing directions". Of the twenty portolan charts of the 1300s that escaped oblivion, the best known is the Catalan Atlas (1375).[1]

The portolan charts were drawn on parchment with the coastlines usually in black, now quite faded, bearing an incredibly lengthy and detailed list of place names of ports and features. Other colors employed were gold and red, important harbors being depicted in the latter color. These charts bore a system of radiating lines of direction and constituted the working tools of a danger-filled profession.

Names of two chart makers of the 14th century are noteworthy, Petrus Vesconte and Angellino di Dalorto. On a Vesconte chart (1311) there is a cross within a circle indicating in all likelihood the four cardinal points of the compass and containing as well a map scale. Vesconte also produced an Atlas (1318) and another chart about 1325 that is very well drawn and beautifully colored. Dalorto is known for his portolan chart of about 1325 on which the north is indicated by a star.

In the famous Catalan chart (1375) there is a complete compass-rose forming part of an arrangement of radiating or rhumb lines representing compass directions (loxodromes).

Navigation in the 14th century, in addition to enjoying the advantages of improved charting and sailing directions, benefitted from new or improved instruments. The magnetic needle or compass had come into fairly general use and the cross-staff by which latitude could be ascertained and the angle between two stars measured had been introduced.[2] Towards the close of the century map makers were becoming more realistic and practical. For the first time in medieval mapping Asia was assuming something resembling its actual shape.

These twilight years of the Middle Ages marked the beginning of the most significant period of exploration and discovery in the world's history. In some part this upsurge in man's questing zeal was the result of Christian enthusiasm to spread their gospel across the whole world. Other factors contributed also, including the purely profit-seeking urge of European rulers and merchants. They sought to find an acceptable route to the legendary wealth of the Indies.

In the rise to popularity among mariners of the portolans and portolanos the map makers of Northern Italy played a highly useful and influential role.

4

THE GOLDEN AGE OF DISCOVERY

The period from about 1420 to the end of the 15th century could well be described as the golden age of exploration by Europeans, and especially by the Portuguese. In Portugal the reign of John I (1385-1433) was, on the whole, a peaceful one. If that reign was also epochal it was mainly because of the ambitions and actions of the King's youngest son, the Prince whom the world was later to know as Henry the Navigator. It was a time of great intellectual ferment in Europe. It was in these buoyant years that the compass began to be combined with the wind-rose in active use on shipboard. The invention of printing and its rapid development as an industry speeded up the processes of civilization and revolutionized the dispersion of knowledge, including its distribution by means of maps. In 1450 four cartographers were busily employed on the continent in multiplying copies of Ptolemy's *Geographia.* New instruments, including the quadrant, were entering into use by mariners. All of these dynamic events foreshadowed the arrival of a turning point in world history, the official discovery of America by Christopher Columbus in 1492.

The discovery of the Azores in 1427 was one of the first fruits of the era of Prince Henry the Navigator (1394-1460). Henry had been made governor of the southernmost province of Portugal in 1419 and spent most of the remainder of his life there. He displayed, for those medieval days, a most remarkable interest in matters of navigation. He was the first European statesman to realize that the sea was not a limitation upon man's activities but a highway for his trade and fuller life. It was mainly through Henry's genius and persistent effort that Portugal, out of her own resources and at least a half-century before her more powerful neighbors, led the way in oceanic exploration. One of the important factors in this development was the establishment of a settlement of Portuguese in the Azores, a most significant step in the progress of long-range navigation.

Seven years after the discovery of the Azores, one of Henry's ships commanded by Gil Eanes, rounded Cape Bojador and returned safely from the 'dreadful' areas beyond it. The following year another vessel sailed fifty leagues past the cape and managed to survive the awful Sea of Darkness! By 1446 Fernandez had sailed almost as far south as Sierra Leone. Prince Henry did not live to see the climax of Portuguese exploration and discovery. The peak achievement came in 1487, some 28 years after his death. In August of that year Diaz sailed from Lisbon with a fleet of three ships, making his way southward along the west coast of Africa. By early 1488 he had rounded the long spit of the Cape of Good Hope. The writers of those times had been drawing discouraging word-pictures of the utter emptiness and unspeakable hazards of the region beyond Cape Bojador. This cape, now part of Spanish West Africa, is on the African mainland, south and somewhat east of the Canary Islands. Southwards beyond that point, it was claimed by publicists, no humans could be found, neither trees nor fresh water. Shallow seas with fearful currents offshore and lifeless deserts inshore represented the best that could be expected.[1] In the light of these general beliefs and fearful warnings, the towering nature of the Diaz exploit in the annals of discovery by sea may be more readily realized today.

Prince Henry of Portugal proved to be a natural leader of men, brilliant in the fields of diplomacy and finance. From the Moors the Portuguese had inherited some knowledge of the sciences as well as much sailing lore from the Italians. In addition Portugal had a great maritime asset in its relatively long coastline and excellent ports. By the vagaries of fortune it was a period in history of that nation that produced such an outstanding royal patron of navigators and navigation.

There exists a difference of opinion among historians as to whether Henry founded the School of Sagres (a town in southern Portugal) where astronomers and mappers mingled their knowledge and talents to improve navigation techniques, or whether he merely hired a few learned men to instruct pilots in the art of chart making, the production of improved nautical instruments and in navigation procedures generally. Whether or not he was the founder of this school of mariners, Henry contrived to keep Portuguese seamen knowledgeable in new methods of finding their way across broad oceans. His most important contribution to marine cartography of the Middle Ages was his emphasis on the scientific approach to problems of navigation. He stressed at all times the need for the use of mathematics and astronomy in charting and in steering a course on the high seas.

Reference has been made to the settlement of the Azores. By establishing the Portuguese there Prince Henry achieved much more, in the long perspective of history, than he realized. It was from the Azores that various Mediterranean nations began their voyages beyond all sight of land. It was in the Azores that Columbus lived with his wife's family and it was there that he became heir to the nautical instruments and maps of his father-in-law. Here it was also that he received information concerning geographical and nautical concepts which proved indispensable to the success of his most famous voyage.

It is likely that at this medieval western outpost Columbus first dreamed his dreams of discovery. He convinced himself thoroughly that, in the light of information available to him concerning the shape and size of the world together with the surveying instruments now at his disposal, he could cross the Atlantic to its unknown shores. By cleaving to his dreams, despite discouragements and open ridicule, Columbus made one of the most portentous journeys ever made in the long story of mankind.

Yet it was the Portuguese-born Magellan who achieved, in the circumnavigation of the globe in 1519-20, what Columbus had failed to accomplish — the linking of Europe with Eastern Asia by crossing the Atlantic in a westerly direction, finding the southern extremities of South America and then sailing round Cape Horn.

Under the continuing influence of Prince Henry's wise concepts, immense and lasting glory was won by the pioneering, probing seamen of Portugal. In the process the royal treasury of the nation as well as man's store of knowledge were substantially enriched. Avenues of global travel were opened to the enterprise of European peoples who had become accustomed to regarding their one-eighth of the world as the whole of it. The land to become known as Canada was to experience the impact of Portuguese explorers and mappers on its eastern shores and waters as a direct result of this golden era.

Soon after Columbus returned home from his momentous voyage, the need for a settlement of a threatening international crisis became acute. Spanish claims to all new lands on the other side of the Atlantic were hotly disputed by Portugal and Spain was in no mood to give ground in any argument on the matter. Pope Alexander VI made a laudable attempt to mollify the rivals and to lessen tension between the disputants. His Holiness, in a Bull of Demarcation of May 3, 1493, two Bulls on May 4th, followed by another shortly afterwards, laid down the Papal law on the issue. He drew an arbitrary meridian from pole to pole on a north-south line one hundred leagues west of the Azores. The Spanish zone, in which all lands could be claimed by Spain, was to the west of that line, the Portuguese zone was to the east.

This was a noble, well-intentioned gesture by the Vatican in the interests of a peaceful settlement and represented an early important diplomatic effort in the Western World to delineate what has come to be known in the 20th century as national spheres of influence. But these Papal actions formed only the preliminaries to the main event, which was the Treaty of Tordesillas of September 5th, 1494. Following the move of the Vatican in the matter, the King of Portugal and the Spanish sovereigns commenced negotiations leading to a treaty. Thus the Papal Bulls became inapplicable and a new line of demarcation was established 370 leagues west of Cape Verde. The final arrangements on the disposition of the issue were made, therefore, not by the Pope but by the heads of the states directly concerned. Although the monarchs of England and France of that day paid little or no attention to the declared demarcation line of the treaty provisions, Portugal and Spain did respect, in the main, this formal agreement.

The Pope's preliminary action and the treaty itself served to emphasize the pressing need of a practical method for finding longitude aboard ship. The growing catalogue of marine disasters by shipwreck acted as an equally impressive spur to the now desperate search for some workable device. More and more it was becoming evident to leaders of western thought that the invention of an accurate timepiece, capable of reliable operation on a storm-tossed vessel, was the real answer to the longitude-fixing problem. But the world was as yet a century and a half away from the appearance of the Harrison Clock. Not that there was any absence of timekeepers in those far-off days. The earliest clocks in use in Europe appeared in the 13th century.[2] These clocks were corrected by sundials and by rough and ready astronomical observations. Stars remained the true timekeepers for man and his world as this globe rolled along in its sun-centred orbit.

Similar difficulties afflicted the finding of latitude on any ship in more or less violent motion. Martin Behaim, eminent navigator and cartographer, was appointed by King John II of Portugal to a special committee which achieved improvements in the astrolabe. Columbus in the journal of his first voyage notes:

"On February 3, 1493, the North Star appeared very high as it does off Cape Vincent. The Admiral was unable to take the altitude either with the astrolabe or with the quadrant because the rolling by the waves prevented it."[3]

We know that the astrolabe was in use by Persian and Arabian astronomers in very early times. Its invention is ascribed to Hipparchus about 150 B.C. and the instrument was improved by Ptolemy about 130 A.D. It was used to measure any angular height by sighting on a star or the sun. European seamen were using quadrants to determine latitude as early as the beginning of the 15th century. The quadrant was a simple instrument, held in a vertical plane then tilted so that the sun's rays penetrated the pinhole sights in the two plates set at right angles on the straight edge. The thread on the plummet would then indicate the altitude of the sun by the scale on the curved edge of the instrument.

Vasco da Gamma had a similar experience to that of Columbus. In 1497 on reaching St. Helena he went ashore with a large wooden astrolabe in order to fix his latitude.[4] His portable instrument had been unreliable on ship deck during the voyage as he tried to obtain the meridian altitude of the sun. But once firm ground was attained, the astrolabe afforded a fair working solution to the finding of latitude, allowances being made for the inexactitude of imperfect instruments.

On the mapping side of European geographical activity during the 15th century there had been a number of significant developments. Fra Mauro's world map, an incomplete copy of which survives today in Venice, marks the peak of medieval cartography and the transition from medieval to Renaissance map making.[5] This was the century that saw also a remarkable revival of Ptolemy's popularity. In 1492 the first edition of Ptolemy's *Geographia,* minus the maps, was published. Three years later the famous and very fine Rome edition of the *Geographia* appeared, complete with maps produced by the copper engraving process. In the page margins, degrees of latitude and longitude were listed. But the supreme height of Ptolemy's Renaissance influence was reached in 1513 with the printing of the Strasbourg edition of the *Geographia,* containing 47 maps produced by wood cuts.

By 1490, on the eve of the first Columbus voyage, Martin Behaim had produced a globe at Nuremberg. For the times, it was an impressive feat. But it was not free from serious defects. For example, Behaim placed Asia much too close to Western Europe.

In 1491 Christopher Columbus was occupied in petitioning the Spanish sovereign, Isabella, for royal sponsorship of an exploratory voyage across the western ocean. In that same year in the Brittany coastal town of St. Malo, Jacques Cartier was born, a man whose navigational skills and achievements during the following half century were to help to shape the future of the New World, so dramatically revealed by Columbus, and to profoundly influence the development of that part of it soon to be known as Canada.

5

THE RENAISSANCE IN THE ARTS OF MAPPING AND SURVEYING

Surveying

In the concluding phases of that rather indeterminate epoch called the Middle Ages, Europe experienced a remarkable flowering of the human spirit and intellect in a period described by historians as the Renaissance. During this span of time there was a shattering of mental and physical shackles imposed by an over-rigid traditionalism. In almost every sphere of human activity, in business, geographical discovery, the arts, engineering, astronomy, Christian beliefs and functions, there was a spectacular blossoming of new ideas, a seeking for fresh approaches and a revival of the classical concept of man and his world. It was at one and the same time a change to a more liberal and to a more practical attitude on the part of mankind in the Western World.

England had been well prepared to welcome the influence of the Renaissance. She had concluded a century and a half of turbulence from which had emerged so many of those characteristics that have since distinguished her nationhood; the institution of parliament, of courts of law, a system of land tenure and of local government and of a popular speech that became within the span of another century the agency and instrument of an imperishable literature.

The Renaissance was a period not to be defined within strict chronological limits. It was marked by such revolutionary events as the application of the invention of printing, the exploration of the Indian Ocean and the discovery of America, to extend immeasurably the scope of human thought and knowledge. By 1558 England's Elizabethan Age began to shine brightly across the turning pages of history. Her exploring mariners, dauntless scientists and literary giants began to accomplish formidable feats.

The 16th century was the century of Elizabeth. In the science and art of mapping it was the century of Waldseemüller, Ruysch and Behaim of Germany, of the Homems and Reinels of Portugal, of Ortelius and Mercator of Holland and of Agnese, Zalteri and Cantini of Italy. In the realm of surveying there were pioneers such as Frisius, Snellius, and Cole, the instrument maker. In exploration it was the time of the Cabots, the Corte-Real brothers, of Cartier, Frobisher and Davis. It was the age of Newton, Shakespeare and Luther. It was the century of Galileo and of the birth of the telescope which, in turn, meant the beginnings of a truly scientific approach to the solving of the increasingly urgent problem of finding longitude at sea as well as the baffling challenge of map projection. It was a flourishing age in terms of printing and publishing, with leaders such as Ortelius on the continent and Hakluyt in England. It was the century of the Atlas, of vast forward strides in the engraving of books and maps. The century ended with the outlining of Canada in crude cartographic style, depicting its three ocean boundaries.

The Middle Ages had given way to the Renaissance and novel industries and enterprises blossomed in a favoring climate of greater freedom of spirit and ideas. The persevering, confident attitude of Columbus had released vast human energies in many directions. He had overcome the paralyzing fear of the unknown as well as the baffling and disturbing behavior of a ship's compass on any long voyage. When Rodrigo de Triana on the *Nina* shouted out on the morning of October 12, 1492, that he had seen land — a New World was revealed and an Old World changed forever.

The events and developments of the second half of the 16th century left an indelible impression upon the affairs of men, including those of the rapidly expanding realms of surveying and mapping. In 1564 Galileo Galilei was born in Florence, Italy. The light of his genius illuminated many fields of human thought and activity but on none did it shine more brightly than on the science of astronomy. His concepts of this world and its relation to the universe opened doors to measureless research and unlimited discovery. Among his most significant contributions to science was the early improvement, if not the invention of the telescope. It was Galileo's methods, introduced in 1609 and subsequent years, of increasing the magnifying powers of the telescope that made possible the efficiency, reliability and accuracy of modern surveying.

At the time of his death in 1642 Galileo was blind, under official surveillance by hostile authorities and newly-bereft of a much beloved daughter. In that same year there was born in England a frail, undersized infant, a child who overcame severe physical handicaps to display in the prime of his long life one of the most powerful intellects the world has known. In the language of Wordsworth, as the poet reflected over a statue of Isaac Newton, with his prim and silent face, the memorial seemed to represent:

> "The Marble index of a mind for ever
> Voyaging through strange seas of thought, alone."

Like Galileo, Newton not only observed but comprehended some of the basic physical laws of nature. By his unexampled genius this Englishman ventured farther than any man had done in formulating concisely and understandably the fundamental principles that govern the operation of the universe.

The 16th century was indeed one of intellectual giants. The same year that Galileo first saw the light of day, a third child, christened William, was born in the month of April to John Shakespeare and Mary Arden in Stratford-on-Avon. In the course of 37 plays and numerous sonnets written during a rather abbreviated lifetime the Bard of Avon turned a most revealing searchlight on his fellowman, his innermost motives and outward behavior. He gave entertaining expression to many facets of life and living, including more than a few appropriate observations on the arts of surveying and mapping.

In England in the latter half of the century there were some significant stirrings in the field of surveying. In 1567, for instance, William Bourne wrote a manuscript on triangulation and on astrolabes. This pioneer surveyor made his way down the River Thames using a mariner's compass as his only instrument. With the compass he got the direction of every reach of the river and fixed his position at the end of the reach by taking bearings on two objects already fixed by a triangulation of the area. When Bourne measured his base line, in order to guide him in setting the scale, the surveyor's chain or "wyer line" was in common use among map-making surveyors of the time. Incidentally, Bourne repeats in his manuscript the warning on compass variation, namely, do not tamper with the compass needle to make it balance and "stand due north".

It was in 1529 that Gemma Frisius, at the age of 21, published in Latin the first edition of *Cosmographia* by Peter Apian. In 1530 he issued a work notable for its description of arriving at longitudes by carrying a timepiece from place to place. In fact it was Frisius who also suggested that in order to solve the problem of ascertaining correct longitude at sea, astronomical observations ought to be combined with a standard of time carried by the observer. But it was in the second edition of the Apian work in 1533, also in Latin, that Frisius gave in detail what he claimed to be an entirely new method of surveying a large area without recourse to one direct measurement! The method was based upon the formula that if all angles and the length of one side are known, then the exact lengths of the other two sides of the triangle may be determined merely by calculations on paper.

It is true that Frisius was first in the publication field with a detailed description of the method but even this feat was preceded by an early 14th century English manuscript on the subject, a manuscript that has been reprinted by Halliwell.[1] But it may be safely assumed that even this English study was not the primary discovery on the triangulation method of surveying. It is altogether likely that the application of the principles of the triangle to practical measurements, originated in classical antiquity.

It was almost a century after the Frisius publication before another Dutch astronomer and mathematician got the idea successfully off paper and into actual practice. Willebrord Snellius, a Leyden University professor, laid down a base line surveyed by triangulation in the year 1615. He used a quadrant and a semicircle for required astronomical observations but did not employ a ground-measuring instrument. The speedy adoption of the triangulation method was hampered by the absence of any reliable table of logarithms. There were other impediments as well. The average surveyor in those days did not have the training or knowledge of mathematics demanded in the use of various geometrical devices involved in the practice of triangulation. It was to meet these needs that the plane table came into wide use.

The first stage in the plane-table development is found in the Holometer of Abel Foullon. In Paris in 1551 he published a full description of his instrument. The Holometer consisted of a table with a small compass inset at its centre and the four quarters of the horizon marked on it. Along one edge was a ruler divided into 1,000 equal parts representing 1,000 paces or toises or whatever unit of measurement the surveyor preferred to use. Besides rulers, there were attachments for horizontal sightings. The table was on a pedestal resting on a ball and socket device, permitting the table to turn horizontally. Foullon's great step forward was to provide on-the-spot sketching on a table in the field. The English surveyor, Ralph Agas, stated in 1566, at the beginning of his career, that he used the "plain table" but in 1571 abandoned it for a "theodelite".[2]

The surveyor's complete outfit in the latter part of the 16th century in England consisted of a "frame for holding down the paper covering the geometrical table", the table with pedestal, "a compasse, pencill, drumme, a stoole, a Squire [square] and a wyer line". The suggestion of the substitution of the drum for the plane table is perhaps a reminder of the efficacy of rapid surveying, even in those days, for military purposes. As for the wyer line or surveyor's chain, its history goes back at least as far as that of the plane table itself.[3]

The Renaissance did more than inspire signal improvements in the art of mapping and the business of map publishing; it marked advances in the theories and practices of surveying. In connection with instruments for use in both surveying and mapping there was a veritable stream of ideas for new devices and refinements of established tools. In addition to new methods of land measurement, including the introduction of the plane table, there was the appearance of the theodolite in crude form. With the improvements to the telescope made by Galileo it was but a matter of time before some bright mind would develop a theodolite that would measure accurately both horizontal and vertical angles by means of a telescope and graduated circles.[4]

The practical surveyor of the 16th century must have found from grim experience how inadequate was an astrolabe for the sort of field work expected of him. The astrolabe was equipped to ascertain what was, in some respects, quite useless to the surveyor, such as the location of the sun in the zodiac or the times of the conjunctions of the planets. Accordingly a simpler instrument for field measurement work had to be devised. Leonard Digges, an English surveyor, is credited with the invention about 1550 of what he called a theodelitus. By the use of this term Digges introduced a measure of confusion in the history of instruments because it was not until he later designed a more complex version that we have anything entitled to be regarded as the ancestor of the modern theodolite. Nevertheless the optimistic Mr. Digges conceived his new instrument to be one of perfection and declared that "no manner, altitude, latitude, longitude or profundity can offer itself, however it be situate, which you may not both readily and exactly measure". This was indeed a far-reaching claim. Unhappily there is no evidence in printed form indicating that such an all-purpose instrument had ever been constructed. But a drawing of it by Dooley was in existence in 1646.

The oldest extant example of a theodelitus of English make is dated 1569 and is a miniature of a larger instrument. It is believed that the instrument was made by H. Cole for Sir Francis Drake and would seem to have been an alidade combined with a circle, square and magnetic compass. Cole described it as a Geometrical Square or, in more modern parlance, a Circumferentor.[5] The incorporation of the telescope in the theodolite probably became widespread early in the 17th century.

There is a document in existence indicating that Cole supplied the first Frobisher expedition with at least £50 worth of instruments, including an astrolabrium. By profession Humphrey Cole was a die-sinker employed at the Royal Mint. But because of the low rate of pay in the craft at that time Cole was glad to get instrument-making jobs on the side. He was an excellent engraver of metals. In 1572 he constructed an engraved map of the Holy Land for the famous Bishop's Bible published by Richard Jugge.

In London in 1575 Humphrey Cole constructed a two-foot astrolabe weighing 30 pounds for the first Frobisher expedition. The astrolabe appears to be the instrument most used by English surveyors of that time. It was carefully adjusted in a horizontal plane and oriented by a magnetic compass and used as a circumferentor. The astrolabe was also used extensively in the first triangulation measurements attempted on the continent of Europe.

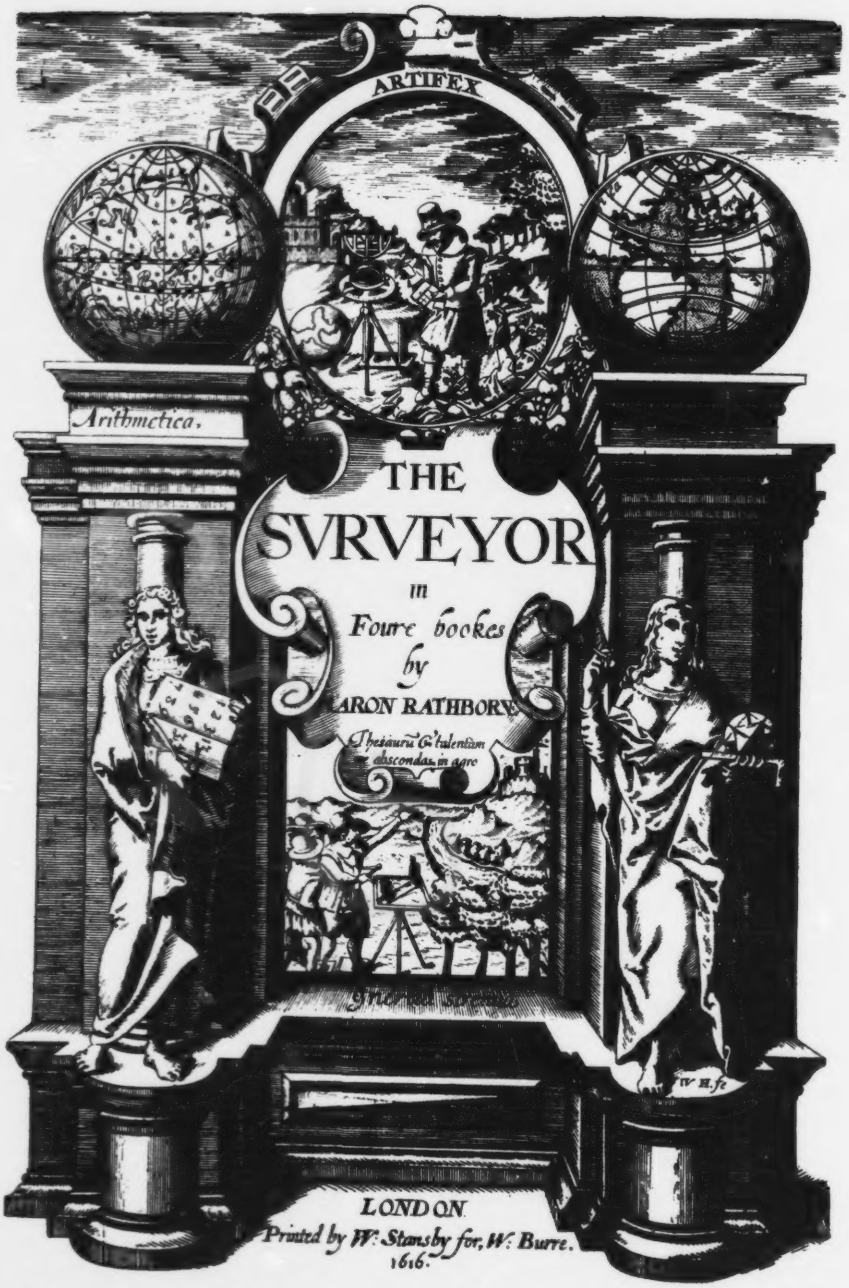

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FIGURE 5. Title page of Aaron Rathborne's four-volume work *The Surveyor* (London, 1616). The upper drawing shows a theodolite; that below, a plane table.

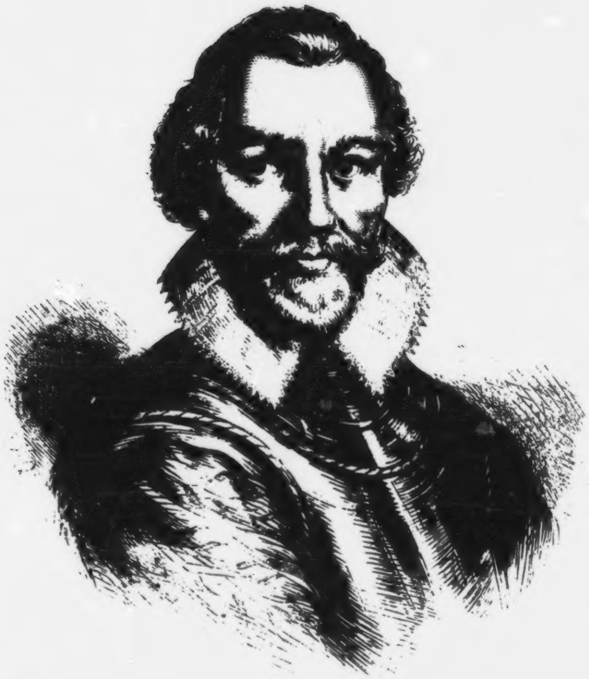


FIGURE 6
Martin Frobisher.

But in the main, during the golden age of discovery, the principal nautical intrument available to man remained the ancient astrolabe. Aboard ship the use of the astrolabe could be a very cumbersome operation. Usually one man held the instrument by placing his thumb through its ring, a second man took the sighting and a third man read off the observations.

The revolutionary idea of mounting the magnetic needle on a compass card depicting the points of the principal winds was another product of Renaissance enlightenment. The compass makers of Nuremberg were responsible for introducing this highly significant refinement to the art of navigation. But it was essential to the ocean-going mariner to know his latitude as well as his general direction. By the middle of the 16th century, because of improvements to angle-measuring instruments it was possible to find one's latitude in two principal ways. One way was to find the altitude of the sun above the horizon; the other, by determining the height of the pole star. Both required the supplementary use of mathematical tables.

Thus by the opening years of the 17th century there were available to guide the mariner across the wastes of ocean such aids as the card-mounted compass, the astrolabe, cross-staff and quadrant. For his part the land surveyor by that time possessed the compass, chain, plane table, astrolabe, the telescope and a primitive type of theodolite. In addition there had been a growing use in Europe of the triangulation method of surveying, pointed up in 1615 by the achievement of Snellius of Leyden in measuring an arc of meridian in this way.

In the realms of mapping, English cartographic enterprise from 1542 to 1547 received strong impetus from the emigration to London of some sixty Huguenot cosmographers from France. To this stimulus was added the inspiration of Martin Frobisher's epochal voyages (1557-58) and those of John Davis (1585-87). In 1582 Richard Hakluyt printed in England a map by one Michael Lok illustrating the extent of English priorities in North America explorations of that time. Meanwhile in 1567 a boy, Samuel, was born to a Biscayan sea captain Champlain and his wife, in the town of Brouage, Saintonge Province. The lad was destined to play a highly influential role in the northern part of the New World to which his fellow-countryman, Jacques Cartier, had so courageously ventured only thirty years previously.

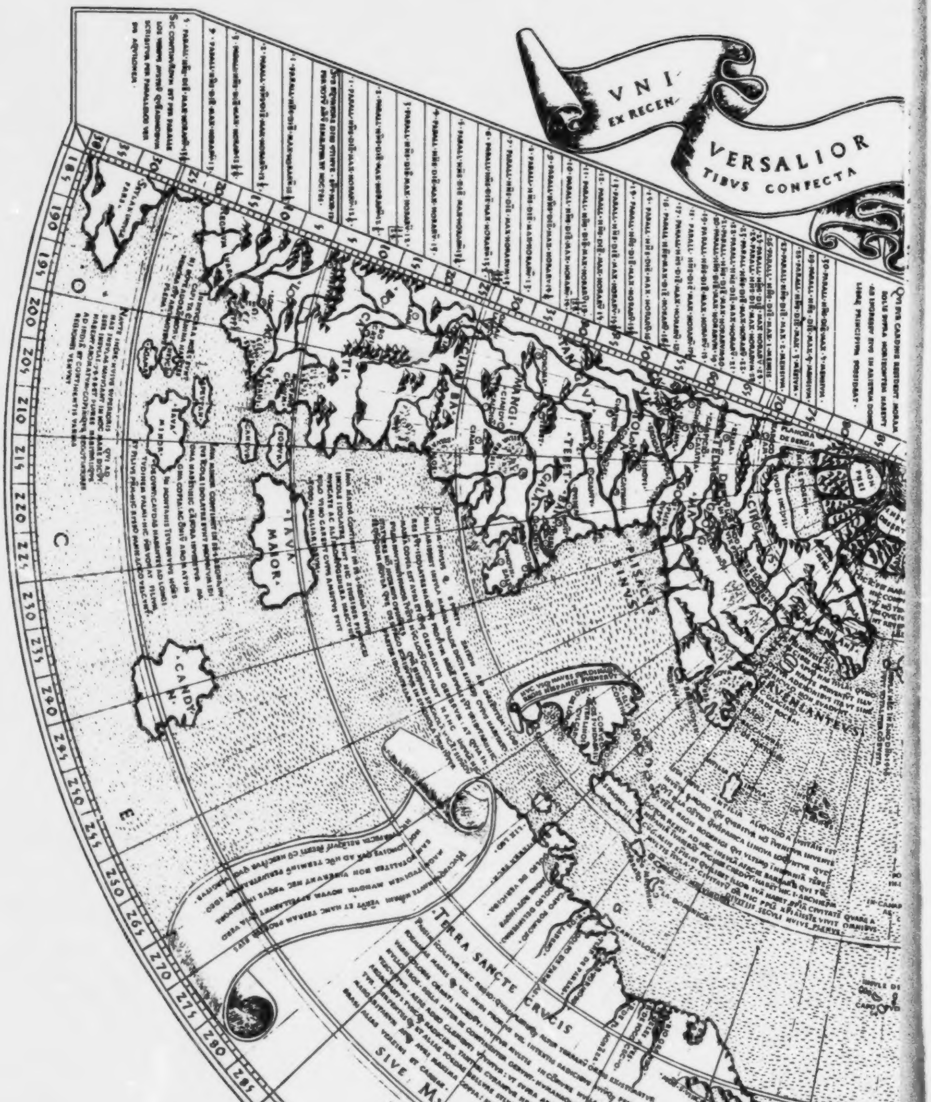
By the beginning of the 17th century and the coming of Samuel de Champlain to New France, many of the navigational hazards, though none of the foul weather risks, had been eliminated from Atlantic crossings. The ship's compass, as we have seen, had been vastly improved by the card-mounted magnetic needle. By means of better instruments and by the knowledge gained by the Cabots, by Cartier, Verrazzano, Frobisher and Davis, some of the mystery of the extent and character of the North American continent had been dispelled. More was known also of the true size and shape of the world. The invention of printing had resulted in the greater multiplication of maps and charts as well as of books. Means of fixing latitude were more readily available and men's minds were turning more and more to the solution of the problem of finding longitude. The art of land surveying was being widely practised in Europe and text-books on the subject had been published. Timekeepers were coming into wide use and their importance in relation to the longitude problem was at least being dimly recognized by leading thinkers of the times.

Two parallel themes may be perceived in the growth of 16th century cartography. Firstly, an evolution of continental outlines in the newly discovered Western World was slowly but surely taking place. Secondly, there was the appearance for the first time of the map of Canada. It is interesting at this stage of the 20th century to observe that several of the present members of the North Atlantic Community had important parts to play in the early exploration and mapping of this country.

Many maps of the newly-discovered continent, including parts of Canada, had been printed and circulated during the 1500s. Even today, in libraries around the world, as many as 1,000 maps of 16th century vintage are preserved which, in one way or other, relate to Canada. As Theodore Layng of the Public Archives of Canada, Map Division, has pointed out — during the century between Cabot's initial voyage to the first venture of Champlain in Canadian colonization, the vast and intricate task of mapping Canada was well begun!

Mapping

The pre-Renaissance concept of a tripartite world (Europe, Asia and Africa) soon crumbled under a cataract of revelations. Geographical discoveries were multiplying with astonishing rapidity in the 15th and 16th centuries. Map makers and map publishers could not keep fully abreast of these new developments. Even so, a new era in mapping had dawned. The tools of the explorer and navigator were being augmented by new instruments or existing ones were undergoing refinements. The magnetized needle, by this time, had been ingeniously mounted on a compass card bearing wind directions. Positions at sea could be fairly well ascertained by use of the astrolabe. The coasts of the Mediterranean were being charted in detail. Portolan charts and portolanos had reached a high peak of attractiveness and utility. As early as 1490 a map by Henricus Martellus portraying the Diaz journey around the Cape of Good Hope had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IAVA MAIOR
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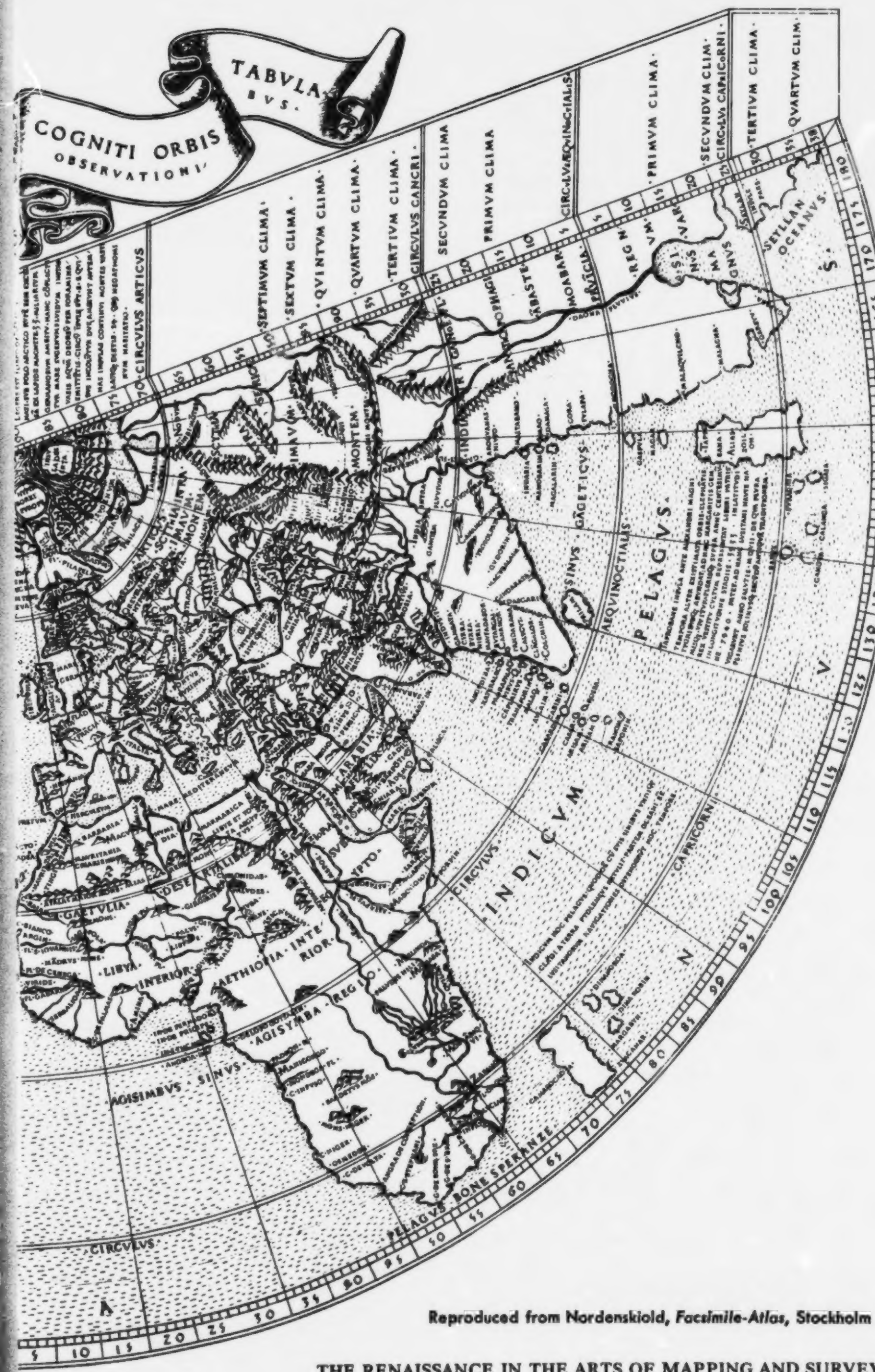
MAP 6. The Ruysch map of the world in Ptolemy, *Geographia*, Rome, 1508.


TABVLA
COGNITI ORBIS OBSERVATIONI-BVS
CIRCVLVS ARTICVS
SEPTIMVM CLIMA
SEXTVM CLIMA
QVINTVM CLIMA
QVARTVM CLIMA
TERTIVM CLIMA
CIRCVLVS CANCRI
SECVNDVM CLIMA
PRIMVM CLIMA
CIRCVLVS AEQVINOCTIALIS
SECVNDVM CLIMA
CIRCVLVS CAPRICORNI
TERTIVM CLIMA
QVARTVM CLIM
SINVS GAGETICVS
AEQVINOCTIALIS
PELAGVS
INDICVM
CIRCVLVS
CAPRICORNI
OCEANVS
LIBYA INTERIOR
AETHIOPIA INTERIOR
AGISYMBA REGIO
AGISIMBVS SINVS
PELAGVS BONE SPERANZE
CIRCVLVS
ARABIA
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Reproduced from Nordenskiold, *Facsimile-Atlas*, Stockholm 1889, pl. 32.

confirmed Marco Polo's report of an unenclosed Indian Ocean.

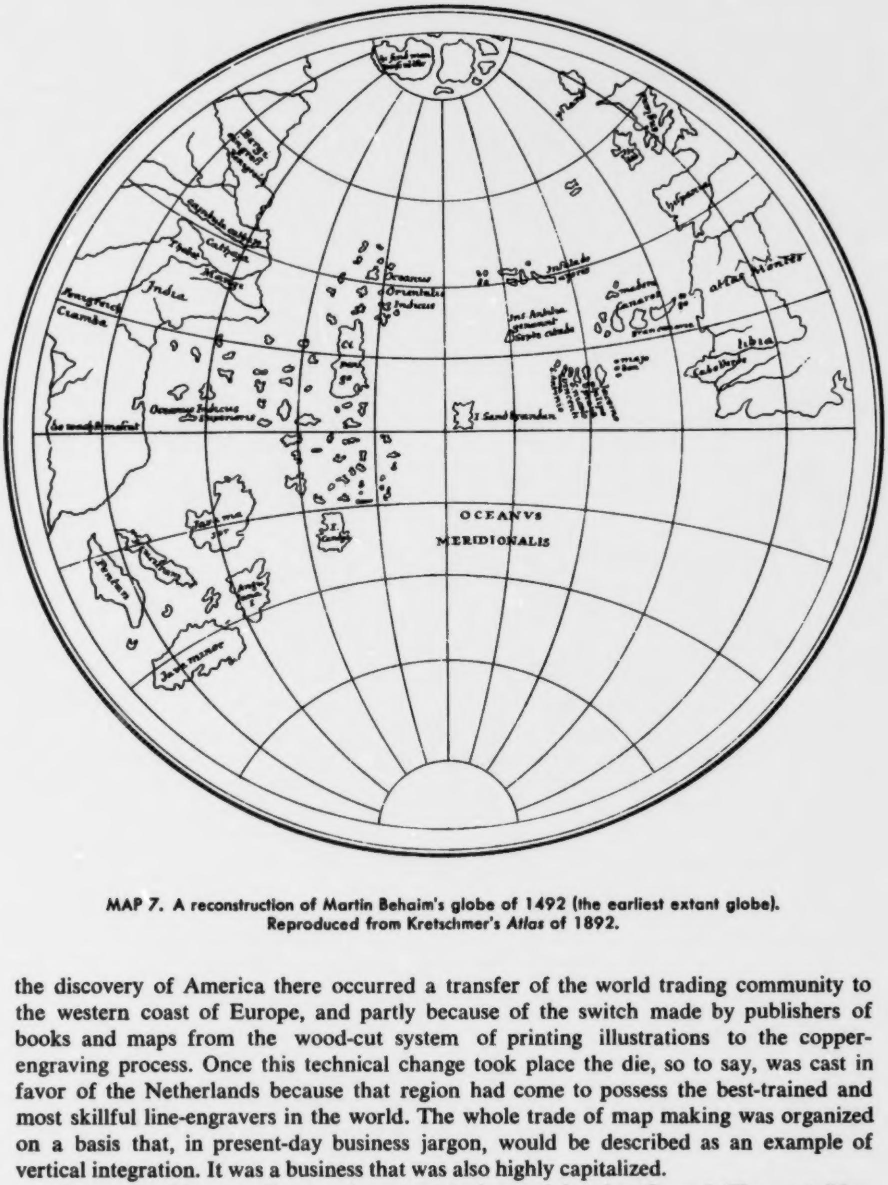
What maps, then, were in existence before 1492 that may have influenced Christopher Columbus to undertake his momentous voyage? Ptolemy's *Atlas*, translated into Latin at the beginning of the 15th century, had been fairly well circulated in western Europe. Although Ptolemy supported the theory of a spherical world, with a circumference amounting to eight times the length of the Mediterranean, he left open the question of the distance between the west coast of Europe and the east coast of Asia.

In addition there was Behaim's globe and the map of Paulo Toscanelli (1397-1482), a noted mathematician, astronomer and cosmographer of Florence. In his famous reply to King Alfonso V of Spain on June 25th, 1474, Toscanelli submitted that ". . . those who sail continually towards the West, when proceeding in this direction, will meet with the same lands as those who go by land towards the East". Toscanelli sent a map to the king to bolster his views but the map has never come to light.

Behaim's globe, which appeared in 1492, included an equator line divided into 360 degrees. It contained also lines representing the Tropic of Cancer and the Tropic of Capricorn, as well as one graduated meridian lying west of Lisbon. Developments of the near future were to reveal one substantial error in the Behaim globe. From Europe westward to Asia the distance was shortened on his globe to the extent of 103 degrees. According to Behaim the distance between the Canary Islands and Japan amounted to slightly more than 3,000 nautical miles rather than the actual 10,000 or more. Nevertheless the Behaim achievement represented a great forward stride in mapping during the era immediately preceding the initial Columbus voyage of discovery. It was among the first globes to incorporate the explorations of Portuguese mariners along the west coast of Africa.[6]

It is altogether likely that John Cabot on his first transatlantic voyage had available to him most, if not quite all, of the information provided in the first edition of *Regimento do Estralabio e do Quadrante*, published in 1509. This work contains corrections to the observed altitude of Polaris as a means of obtaining latitude. Cabot "kept the North Star on his right hand" as he pursued his westerly course. Melvin H. Jackson, in his perceptive study of the 1497 Cabot voyage, points out some of the factors that would affect Cabot's concept of his venture, such as the availability of astronomical tables for ascertaining latitudes. As early as 1464 one of Prince Henry's ship masters used a quadrant at sea for this purpose. Declination of the compass was also known by then and corrections could be applied by a shrewd navigator. Although there were no reliable chronometers in use at the time, dead reckoning was an art, as well as a well-developed instinct, among deep-sea mariners of the 15th century. John Cabot had studied cartography, knew of Marco Polo and could express his own ideas on maps or on globes. As Jackson has indicated, whereas the modern navigator views longitude determinations in terms of angular measurement from an established prime meridian, his medieval counterpart fixed easting and westing in terms of distances rather than by degrees, minutes and seconds.[7]

The discovery voyages of the 15th century unloosed a veritable stream of European-made maps during the 16th century. A significant change took place in this period in the realm of map publishing. Italy, particularly its northern cities, had been the principal area in Europe for the production of maps. Italy was the scene of the great revival of Ptolemy's works in the late 15th century, including the Rome editions of 1478, 1507 and 1508. But by the mid-1500s the map-making and map-publishing activities had shifted to the Low Countries. Antwerp replaced Genoa and Venice, partly because with


Oceanus
Orientalis
Indicus
India
Ciamba
Oceanus Indicus
Superiores
I Sand Brandan
canaries
atlas montes
libia
Cabo Verde
Java minor
OCEANVS
MERIDIONALIS

MAP 7. A reconstruction of Martin Behaim's globe of 1492 (the earliest extant globe). Reproduced from Kretschmer's *Atlas* of 1892.

the discovery of America there occurred a transfer of the world trading community to the western coast of Europe, and partly because of the switch made by publishers of books and maps from the wood-cut system of printing illustrations to the copper-engraving process. Once this technical change took place the die, so to say, was cast in favor of the Netherlands because that region had come to possess the best-trained and most skillful line-engravers in the world. The whole trade of map making was organized on a basis that, in present-day business jargon, would be described as an example of vertical integration. It was a business that was also highly capitalized.

It was in this new climate of map-producing activity that Gerard (Kremer) Mercator (1512-94) was raised in the Netherlands. Born at Rupelmonde in East Flanders in the year that Jacques Cartier attained his majority, Mercator grew into a brilliant scholar. After taking a degree course at Louvain University, as well as lessons in advanced mathematics from Gemma Frisius, young Mercator became a cartographer, engraver and instrument maker. But Cartier was ordained by events to carry out his historic voyages without the benefit of the revolutionary invention of Mercator. Mercator's initial map appeared in 1537, three years after Cartier's first arrival in the St. Lawrence Gulf area. The publication of his new projection in 1569 did not take place until 14 years after Cartier's death.

By the middle of the 16th century the two leading map-makers of Europe, Mercator and Abraham Ortelius (1527-98) were living and working in the Netherlands within 60 miles of each other. But Ortelius was more a craftsman than a geographer. Mercator remains most famous in world history for his invention of a method of map projection, but his map work generally was distinguished by delicate precision and admirable control of detail. He did much also during the latter part of his career to free European cartography from the more stultifying errors of Ptolemy. In 1538 Mercator published his novel double-hemisphere map, the first to show North America and South America. This production preceded by only a few years the first effort of Roberval to colonize Canada, at a time when Cartier was returning to France for the last time. Within 10 years of the issue of the double-hemisphere map, Martin Frobisher was to sail from England on the first of his northern voyages.

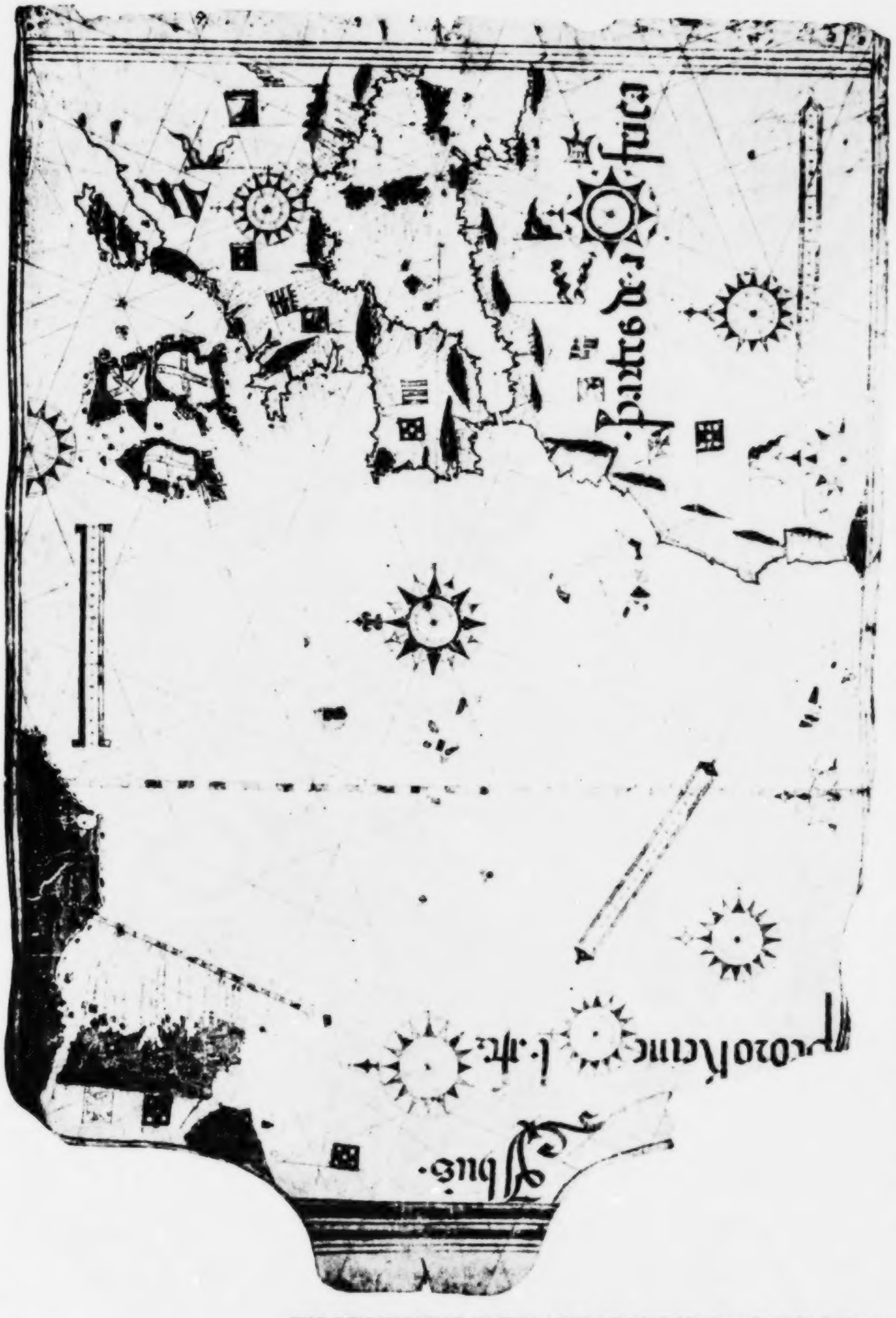
Another Netherlander who did much to assist in the renaissance of European cartography was Petrus B. Apianus or Peter Apian (1495-1551). Born in Leisnig in Bavaria, Apian was considered to be the foremost cosmographer of his period. His chief work, *Cosmographicus liber* was used as a manual in universities for almost a century. First published in 1524 it was later revised and printed in a variety of languages. This editorial work was supervised by Gemma Frisius, one of Apian's pupils. Apian made two important innovations in cartography, Bacon's equidistant meridian projection and the stereographic polar projection. He was the first to propose determination of longitude by measuring moon distances.

Martin Waldseemüller, a geography teacher, effectively publicized the fact that North America was a separate continent. Waldseemüller compiled a large map of the New World and published it in two editions in 1507. This was the *Cosmographae Introducto.* It proved popular and was reprinted many times.

The Dutch, it is true, had overtaken and passed the Italians in the cartographic business but the Portuguese were not by any means dormant in map-making and chart production. The Homem family, for example, was responsible for an illustrious series of maps bearing their name, including Lopo Homem's of 1554 and Diego's of 1558 and 1568. These and other maps from this source presented an improved configuration of both Newfoundland and Nova Scotian coasts and for the first time in the history of cartography represented the outline of the Bay of Fundy. Another important feature of the Homem maps was the inclusion of North American Indian place names. Much of the nomenclature introduced to mapping by the Homems has survived to the present.

Another leading family of Portuguese cartographers in this period was the father and son combination of Pedro and Jorge Reinel. They flourished in the immediate post-Columbus epoch. Pedro was described as a "master of charts and of navigation compasses". Jorge was known as an "examiner in the science and art of navigation". Their charts of the Atlantic Ocean constituted some of their best work. Probably one of the most interesting of the earliest Portuguese charts is that of Cantino, drawn about 1502. It contains the lines of the equator and tropics. The Tordesillas demarcation line is also inserted.

Much of the work of these Portuguese cartographers was inspired by and based

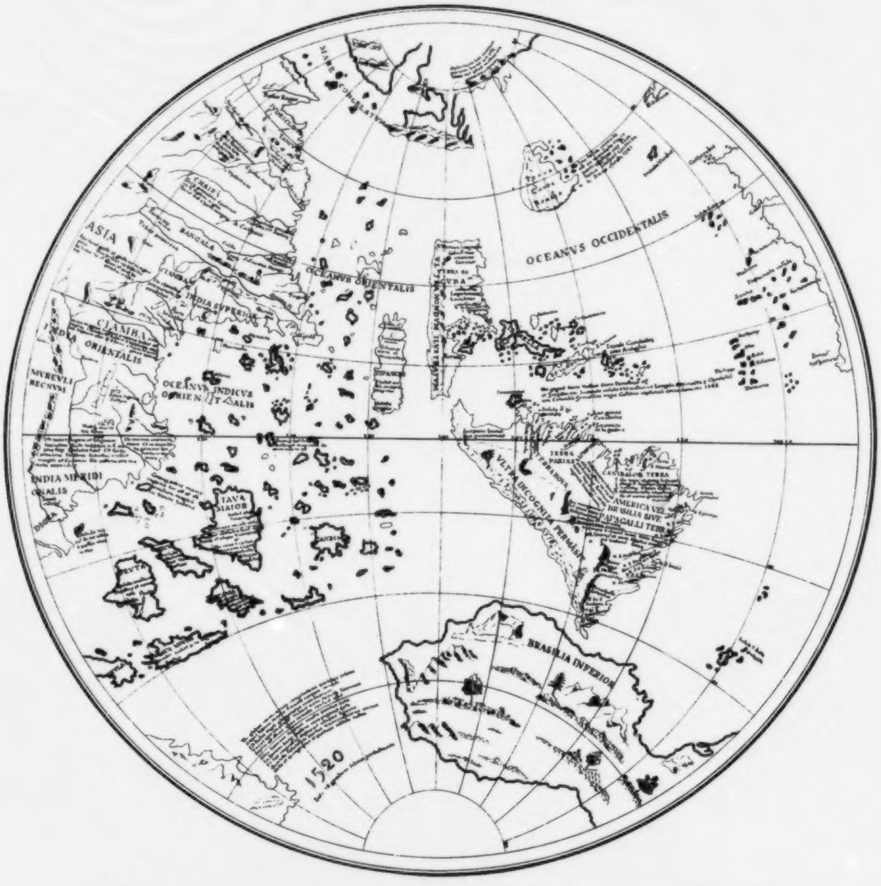


MAP 8. Portuguese manuscript chart of the North Atlantic by Pedro Reinel, preserved in the Staatsbibliothek, Munich (c. 1516). Reproduced from a copy in the Public Archives of Canada.

upon voyages such as those by the Corte-Real brothers, Gaspar and Miguel, from 1500 to 1502. Both men lost their lives in these ventures but enough evidence of their voyages survives to indicate that they ranged from Greenland to Cape Race.

Juan de La Cosa, owner and captain of the *Santa Maria* and an expert Biscayan navigator, produced at the commencement of the 16th century his famous map showing an east-west named coast, in the latitude of Bristol, that has long been assumed to represent Cabot's discoveries. Originally drawn on oxhide, it bore a scale, so far undeciphered, in addition to a compass rose, and direction lines. Degrees of latitude or of longitude were not indicated.[8] There has been lively controversy among map scholars over the authenticity of the map itself. Experts have turned to a closer study of the Cantino (Portuguese) chart of 1502 that shows a north-south line of coast, territory

GLOBUS DES JOHANNES SCHÖNER VOM JAHRE 1520.
STADT-BIBLIOTHEK ZU NÜRNBERG


ASIA
BANGALA
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INDIA ORIENTALIS
OCEANVS ORIENTALIS
OCEANVS INDICVS ORIENTALIS
INDIA MERIDIONALIS
IAVA MAIOR
ZIPANGRI
OCEANVS OCCIDENTALIS
TERRA PARIAS
CANIBALOR TERRA
AMERICA VEL BRASILIA SIVE PAPAGALLI TERRA
VLTRA INCOGNITA
BRASILIA INFERIOR
1520

MAP 9. An early representation of the Americas from a map in Kretschmer's *Atlas*, 1892.

claimed by the King of Portugal on the basis that it was discovered by Gaspar Corte-Real. In the view of T. E. Layng, whether the La Cosa or Cantino maps contain the first line may well depend upon the final interpretation of a third chart of this period, the Oliveriana of Italian origin, completed about 1506.

French interest in the New World began with the Verrazzano expedition of 1534, a venture followed up by the Cartier voyages so memorably portrayed by the handsome and impressive charts produced by the newly-formed Dieppe school of hydrography. It was this school of hydrographers that first recorded on maps the beginnings of a French empire in America. Map makers of this school included Jean Rotz, Pierre Deceliers and Desliens. The important Mercator maps of 1538 and 1541 failed to transmit any new geographical knowledge of the Gulf of St. Lawrence, beyond separating Newfoundland from the mainland by a north-south strait. Actually the St. Lawrence River did not appear on European maps until about 1542. And it was not until 1569 that Newfoundland began to resemble its true form in these representations.

Diogo Ribeiro (?-1533), another eminent mapper of the New World, was a Portuguese cosmographer in the service of Spain. At Seville he was responsible for revisions in the official map as new discoveries were reported. His 1529 map is noteworthy in the growing cartographic output of the early 16th century because it depicts for the first time a continuous coastline connecting the Portuguese and English possessions in the north with Spanish possessions in the south. By this map Ribeiro reveals more than ordinary awareness of the nature and extent of the newly-discovered territories. He records the finds of the explorer Gomez, who examined the Labrador coast and shoreline southwards in 1525. Due to this mapping record the Gomez venture, in terms of publicity, eclipsed the voyage made in the same regions one year earlier by Jean de Verrazzano, exploring in the name of France.

One of the outstanding men of the Renaissance in European navigation was Petro de Medina, described as the founder of the literature of seamanship. His *L'arte del Navegar*, published sometime before 1554, was printed in a number of languages and was the first publication of its kind to become popular among mariners. Frobisher carried a copy of de Medina's work on the first of his northern voyages.

In the Europe of the times the establishment of a family tradition of fine craftsmanship was not confined to cartography. In map publishing the name of Blaeu became synonymous with excellence of product. As a young man Willem J. Blaeu (1571-1638), destined to become Map Maker to the Republic (of the Netherlands) went to Uraniborg to study under the noted Danish astronomer, Tycho Brahe. Brahe appears to have had a well-equipped observatory at his disposal and he gained considerable prestige as an instructor. Willem Blaeu's initial cartographic efforts consisted of two globes, one completed in 1599, the other in 1602. He published his first atlas in 1631*. It was composed of 103 maps, accompanied by a Latin text. Willem's two sons, John and Cornelius, kept the Blaeu firm name supreme in map publishing for many years. Possibly the peak achievement of the Blaeus was the publication in 1663 of an *Atlas Major* in 12 volumes accompanied by a French text.

In England one of the outstanding names in the science of geography in the 16th century was Richard Hakluyt (1553-1616). He commenced at Oxford University (of which he was a graduate) the first public lectures in geography "that shewed both the old imperfectly composed and the new lately-reformed mappes, globes, spheares and other instruments of this art". Hakluyt's first published work (1582) was *Divers Voyages touching the Discoveries of America*. In 1588 he published *The Principall Navigations, voiages and Discoveries of the English Nation*. In the preface of the book was an announcement of the first terrestrial globe made in England by Molyneux. Some copies of the edition issued in 1600 of the 1588 book contain a rare map, the first on the Mercator projection to be made in England according to the principles laid down by Edward Wright, of Cambridge. Wright had published mathematical tables enabling mariners to apply corrected measures to distances shown on Mercator's projection. Richard Hakluyt, whose remains rest in Westminster Abbey, devised a system of rolling maps and yet, as he pointed out, "most dwelling houses are not spacious or light enough to contain a large map fully spread out".[9]

All this spirited activity among European geographers, map makers and map publishers derived from the discovery of America by Christopher Columbus. Columbus died in 1506 fully convinced that the lands discovered by him were parts of the coast of Asia. In all likelihood that concept is the reason for the continuing application of the term 'Indians' to most of the native peoples of North America. Cabot, sailing somewhere along the northeastern seaboard of Canada, was under the impression that he had reached a great northeasterly projection of Asia. It was in this climate of confusion that cartographers attempted more or less valiantly to reconcile shapes of newly-found coasts with the all-too-vague data that mappers possessed of the eastern shores of Asia.

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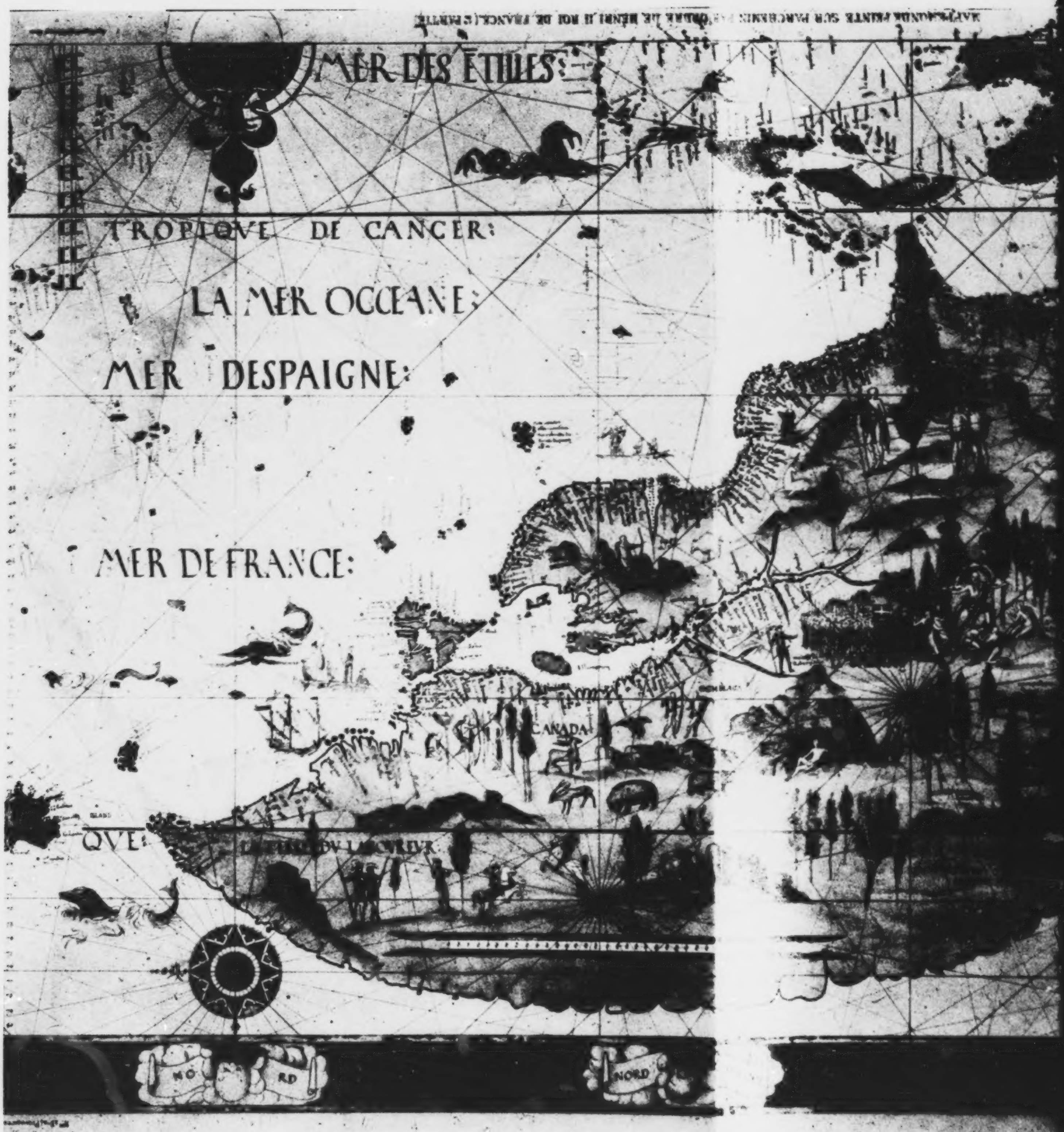
*Most of the early atlases mentioned in this chapter are available in the Map Division, Public Archives of Canada, for consultation by scholars.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MER DESPAIGNE:
MER DE FRANCE:
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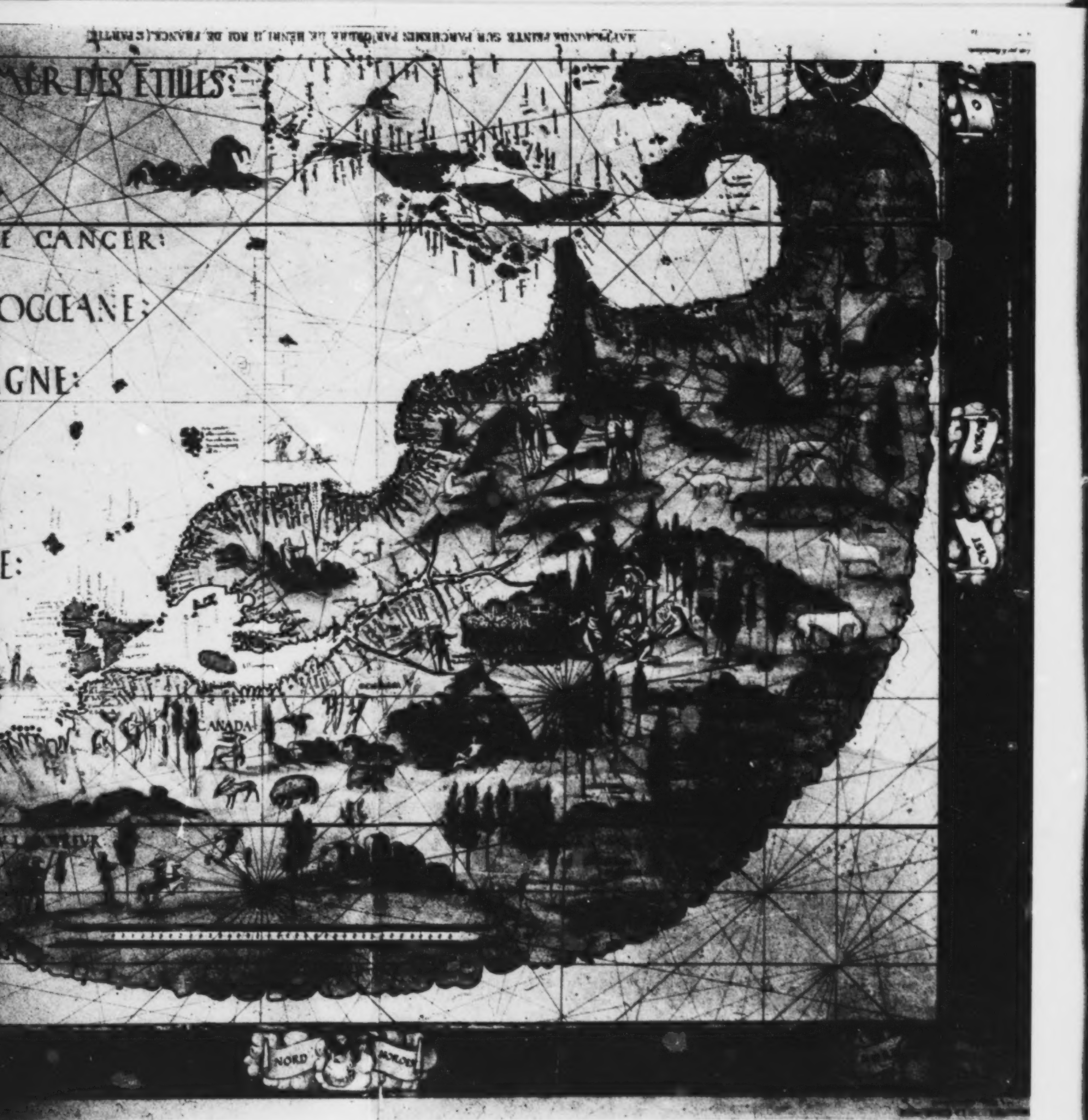
Section from a manuscript map of the world in the John Rylands Library, Manchester, made by Pierre Descellers, 1546. (Reproduced from J. Jomard



AER DES ETILLES:
E CANCER:
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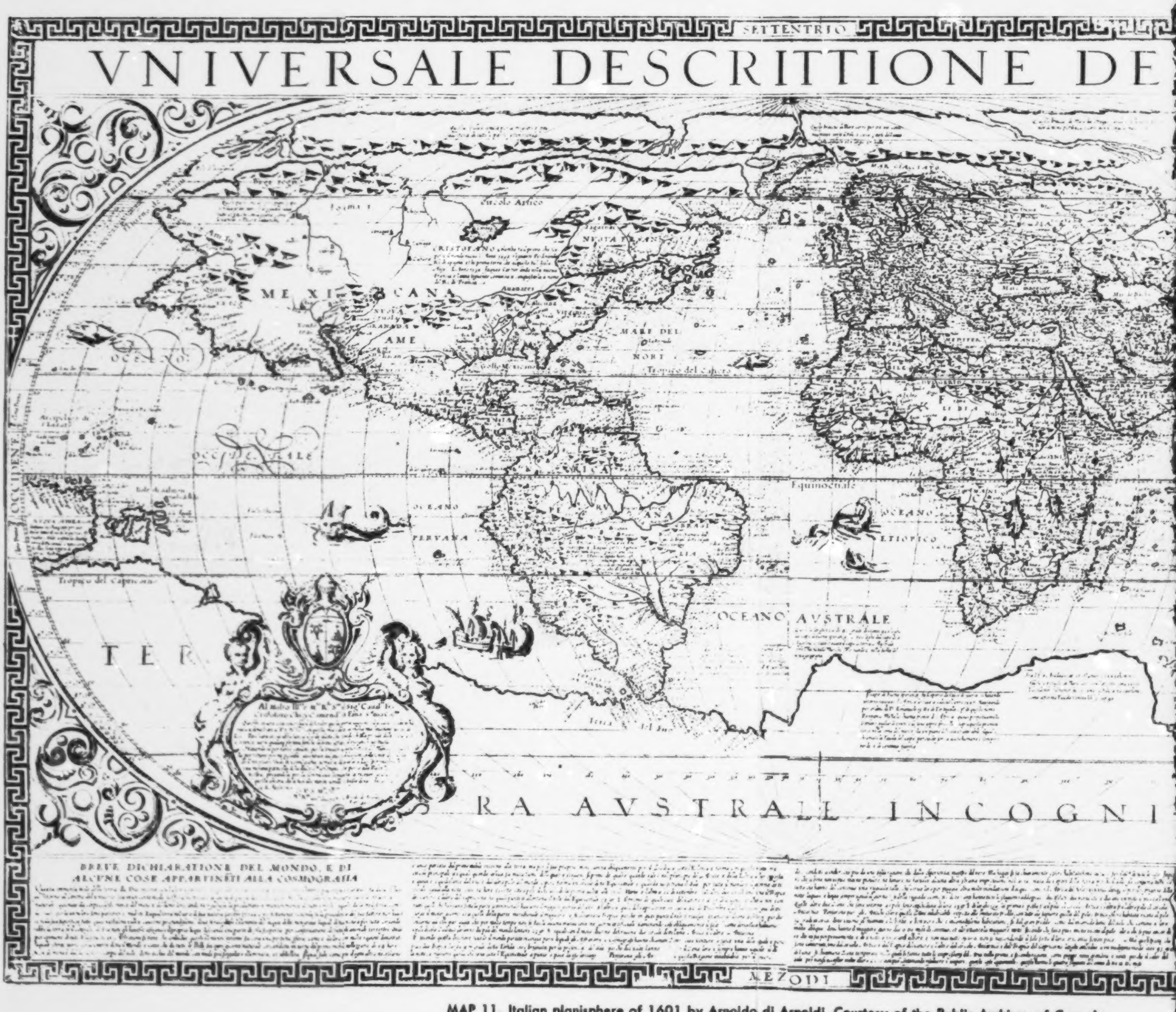
the John Rylands Library, Manchester, made by Pierre Descellers, 1546. (Reproduced from J. Jomard, Les Monuments de la Géographie, Paris, 1859).


SETTENTRIO
VNIVERSALE DESCRITTIONE DE
circolo Artico
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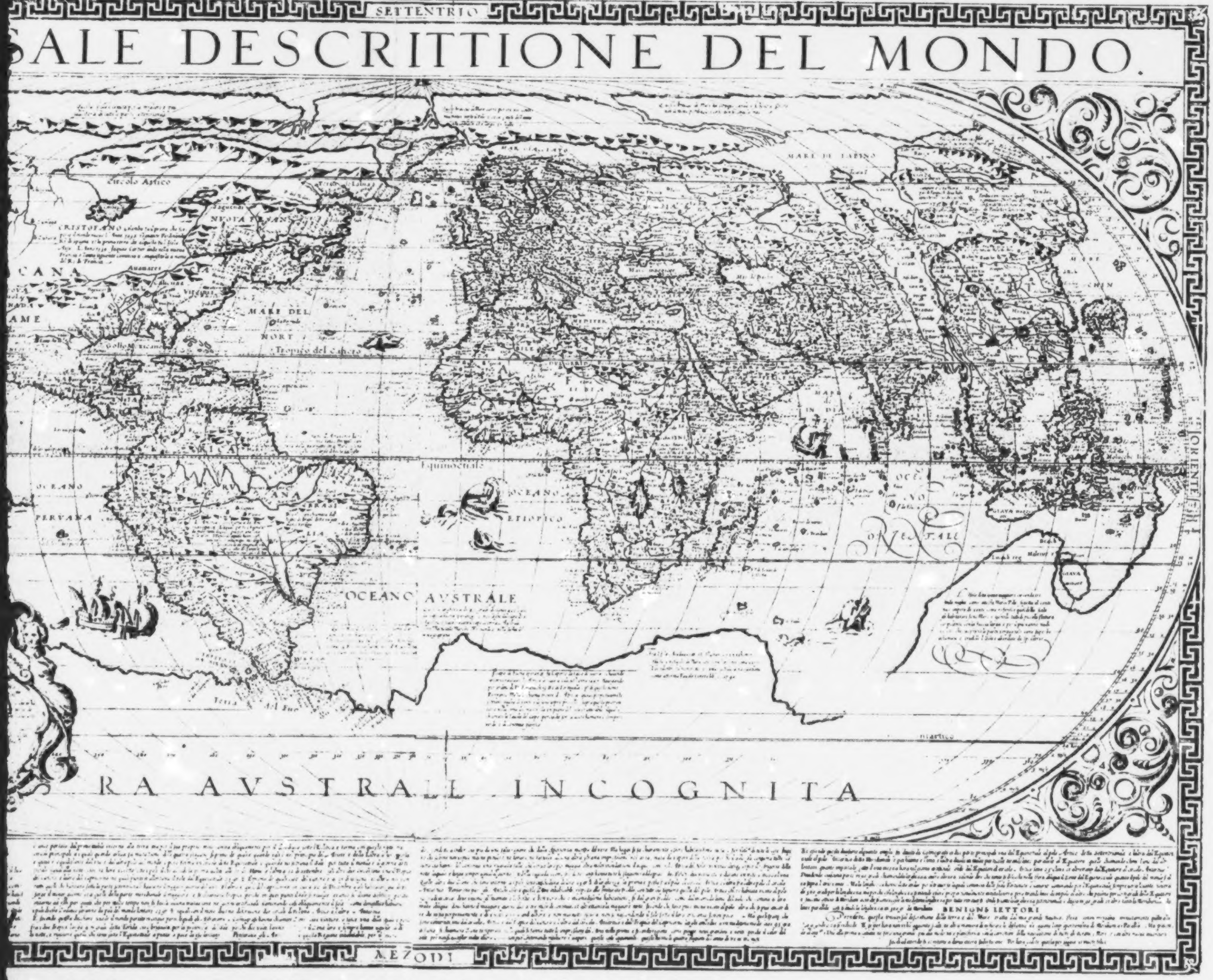
OCEANO
OCCIDENTALE
OCCIDENTE
Equinoctiale
OCEANO PERVANA
OCEANO ETIOPICO
Tropico del Capricorno
OCEANO AVSTRALE
TER
RA AVSTRALE INCOGNI
BREVE DICHIARATIONE DEL MONDO, E DI ALCUNE COSE APPARTINENTI ALLA COSMOGRAFIA
MEZODI

MAP 11. Italian planisphere of 1601 by Arnoldo di Arnoldi. Courtesy of the Public Archives of Canada.


SETTENTRIO
SALE DESCRITTIONE DEL MONDO.
Circolo Artico
NUOVA FRANCIA
CANA
MARE DEL NORT
Tropico del Cancro
Equinottiale
OCEANO ETIOPICO
OCEANO AUSTRALE
PERVANA
Terra del Fuo
ORIENTE
RA AVSTRALI INCOGNITA
BENIGNI LETTORI

MAP 11. Italian planisphere of 1601 by Arnoldo di Arnoldi. Courtesy of the Public Archives of Canada.

6

CHAMPLAIN—THE BROUAGE VOYAGEUR

The dean of land surveyors in Canada, "le père des arpenteurs-géométres du Canada" is undoubtedly Samuel de Champlain. Born at Brouage in Saintonge Province, 7½ miles west of Rochefort, France, Champlain could claim active service as a soldier and sailor before he was appointed a geographer by Henry IV. It is certain that by far the largest part of Champlain's surveys in the New World were related to land rather than to navigation. Yet he was a navigator by nature and instinct. In his writings he observes, "of all the most useful and excellent arts, that of navigation has always seemed to me to occupy the first place . . . This is the art which won my love in my early years. . . ." Champlain's name will be forever illustrious in Canadian history because of his pioneering achievements and outstanding ability in the fields of colonization, exploration surveys and mapping.

In the earliest years of the French regime, Royal Engineers and Royal Hydrographers carried out land surveys. Later, surveyors instead of receiving their appointments from the monarch, obtained licences to practise, documents in the form of certificates of competence granted by le Collège des Jesuites at Quebec. In the official membership listings of today's records kept by the Land Surveyors' Corporation of the Province of Quebec, Champlain is proudly accorded primary place, his formal admission being dated 1608.

It was in 1603 that Champlain made his first voyage to Canada in the service of King Henry. He accompanied the Huguenot aristocrat, Sieur de Pontgravé, to the St. Lawrence Gulf and River. Pontgravé was primarily interested in the fur trade and while he dealt with Indians, Champlain explored the impressive headlands and dark waters of the majestic Saguenay River. The following year Champlain, the Brouage voyageur, with a commission to explore the Atlantic coast, accompanied another Huguenot, Sieur de Monts. Champlain, a devout Roman Catholic, was none too happy that in these exploratory ventures he was so closely associated with Huguenots. Yet he yielded again to Huguenot influence in 1607 when he married Hélène Boullé of Paris, daughter of a wealthy Huguenot. While Champlain went off again to Quebec, Hélène completed her education. Two years after the wedding she went to Quebec with him, the first Frenchwoman of gentle birth to sail up the St. Lawrence. Hélène Champlain was the first of many thousands of wives called upon to endure months of loneliness as their Canadian surveyor-husbands engaged in prolonged field work.

Sieur de Monts and Samuel de Champlain skirted the Nova Scotia coast to a river they named St. Croix and which, in time to come, was to provide a baffling puzzle for the international boundary makers. Champlain, as the ever-restless navigator, probed the Bay of Fundy, noting its tremendous tides and discovering the Saint John River with its reversing falls. Finally, sailing through a narrow gap on the Nova Scotia side of Fundy, a gap now known as Digby Gut, he found himself in an extensive protected basin of which he wrote enthusiastically, "two thousand ships could shelter in safety". He named the place Port Royal (Annapolis Basin). Thus in 1605 Champlain and his assistants started to build the first French habitation in North America.

In 1607 de Monts lost his fur trading monopoly and Port Royal had to be abandoned. By 1608 Champlain, with Pontgravé and de Monts, in the year of the discovery of the telescope, had returned to America and to the St. Lawrence. This was the same magnificent waterway travelled by Cartier nearly 75 years earlier and, in part, by Champlain himself five years previously. In his wisdom Champlain laid the foundations of a settlement at "the place where the waters are narrow" or "Kebec" in the Algonquin tongue.

Champlain possessed to a profound degree the insatiable curiosity for whatever lay just over the horizon or around the next riverbend, a curiosity indispensable to success in exploration, surveying or mapping. For a quarter of a century, whenever he could break away from administrative cares at Quebec, Champlain was happily engaged in searching out new country and new watercourses in the company of friendly Indians. His interest had been whetted by reports from tribes of the North who, on venturing down the Saguenay River with furs, claimed they lived near a salt sea. As Champlain speculated on these enticing tidings they renewed his dreams of finding an ocean route to the Orient. But Henry Hudson in his ship *Discovery* had found the Great Bay and wintered on its shores. He, too, had been seeking a Northwest Passage and, all too soon, paid for his ambitions with his life.

Champlain exerted every effort to build up a farm colony at Quebec. The mercantile companies of the time, however, interested only in trading in furs, showed utter indifference to the economic welfare of the permanent settlers. Champlain, in fact, was aghast over their apathy. In his own words "they had not themselves cleared an arpent and a half of land in the 22 years during which they were, according to His Majesty's intention, to have peopled and cultivated the colony of Quebec".[1] When he spoke or wrote, Champlain did so with a degree of influence and authority as he had, in 1608, received from the King of France the appointment of lieutenant-governor of the colony.

In 1617 Champlain induced a former Paris apothecary, Louis Hébert, to bring his family to the site of Quebec. Champlain, himself, surveyed and measured out the parcel of land allotted to Hébert. "C'est lui encore qui mit solennellement avec toutes les formalités voulues dans le temps, tous les nouveaux colons en possession de leur exploitation sur le rocher de Québec".[2] ("It was by his (Champlain's) own hand that every settler was solemnly established, with all the required formalities of the times, on his lot on the cape of Quebec."). Hébert was not a complete novice in the New World. He had explored Acadia in 1604 with de Monts and Poutrincourt and had resided there from 1606 to 1613. The merchants were unhappy over the appearance of the Hébert group and went as far as to make matters disagreeable for them.[3]

Despite the fact that Hébert was the first colonist to support his family from the produce of his land at Quebec, the merchants persisted in making "many illegal claims upon him for his yearly harvests and compelling him to sell only to the company—and that at a specified rate".[4] Champlain, as reported in Laverdière's edition of his journals, states that the plow was first used in Canada on April 27, 1628, and was employed, likely with the aid of oxen, by Hébert's son-in-law, Guillaume Couillard. Hébert died on January 25, 1627, as a result of injuries sustained in a fall.

While the little colony at Quebec was struggling for survival, the Pilgrim Fathers (74 men and 20 women)—all English Puritans—were making a landing on New England shores at Plymouth Rock.

Up to 1620 Champlain's residence at Quebec was in its Lower Town, near the existing church, Notre-Dame des Victoires. In the early years of the 17th century Upper Town with its great oaks, walnut trees and majestic elms still formed part of the primeval forest, an area abounding in game. It was in these surroundings that Champlain, with due solemnity, surveyed and laid out new areas needed for development on the site of Quebec.

Nine years after Louis Hébert arrived at Quebec he received on February 4, 1623, what is regarded as the first seigniorial grant of land in Canada. The recipient was described in the grant as "head of the first family settled in the country".[5] The Hébert grant of Sault-au-Matelot was made by the Duc de Montmorency and confirmed on February 26, 1626, by the Duc de Ventadour, and was to be held "on such charges and conditions as shall be hereafter imposed" ("pour en jouir *en fief noble* aux charges et conditions que lui seront ci-après imposées"). This particular grant was one of a total of three seignioral grants made in 1623 and apparently the only such grants made during the period 1608 to 1627. Each of the three grants was made on the advice of Samuel de Champlain. The terms, or rather the lack of them, would indicate that no general land-tenure policy had been formulated by French authorities up to that time.

In laying out the seigniories of New France the linear arpent of 180 French feet was used as the unit of measurement and is variously computed as being from 191.83 to 192.3 English feet. This measurement is still the legal unit in all existing Quebec seigniories. The Quebec Department of Crown Lands of modern times computes the arpent as 191.85 French feet. A 1641 map of the St. Lawrence settlements from Quebec to Cape Tourmente reveals that each lot at that time had a river frontage of seven arpents and a depth of a French league (84 arpents) or more. Not all seigniories were oblong in shape. The title deed of Robert Giffard's seigniorial grant at Beauport from the Company of One Hundred Associates, dated January 15th, 1634, was one and a half leagues along the river front and the same distance in depth. This grant of land was on the north shore of the St. Lawrence River just below Quebec.[6]

But the assignment of land concessions in New France generally in the shape of long, narrow strips was obviously designed to secure for each settler a frontage on a watercourse, preferably a large river. In this fashion and by this means they would be adjacent to what was, in those formative days, a principal highway of communication between one another and the world outside. It was felt also that this settlement arrangement would serve to bring inhabitants of the new land into close proximity both for defence and for social purposes. As time and settlement proceeded in the St. Lawrence basin there began to develop misgivings over the wisdom of adhering to this unusual pattern of land tenure, doubts that began to disturb official circles in France.

In Louis Hébert's first season (1617) at Quebec "he presently commenced", according to Abbé Ferland, "to . . . clear the ground on the site on which the Roman Catholic Cathedral and the Seminary adjoining now stand, and that portion of the Upper Town which extends from what is now Ste. Famille Street to the Hotel-Dieu. He constructed a house and a mill near that part of St. Joseph Street where it receives St. François and St. Xavier streets. These edifices appear to have been the first which were erected in the locality now occupied by the Upper Town."[7]

The matter of suitable roads early intruded upon the consciousness of the young colony. In this period (1608-1635) there could only have been narrow, twisting paths in the forested upper levels of the Quebec community. There is no evidence that Champlain or the Scottish invader, Sir David Kirke, troubled much with the improvement of paths.

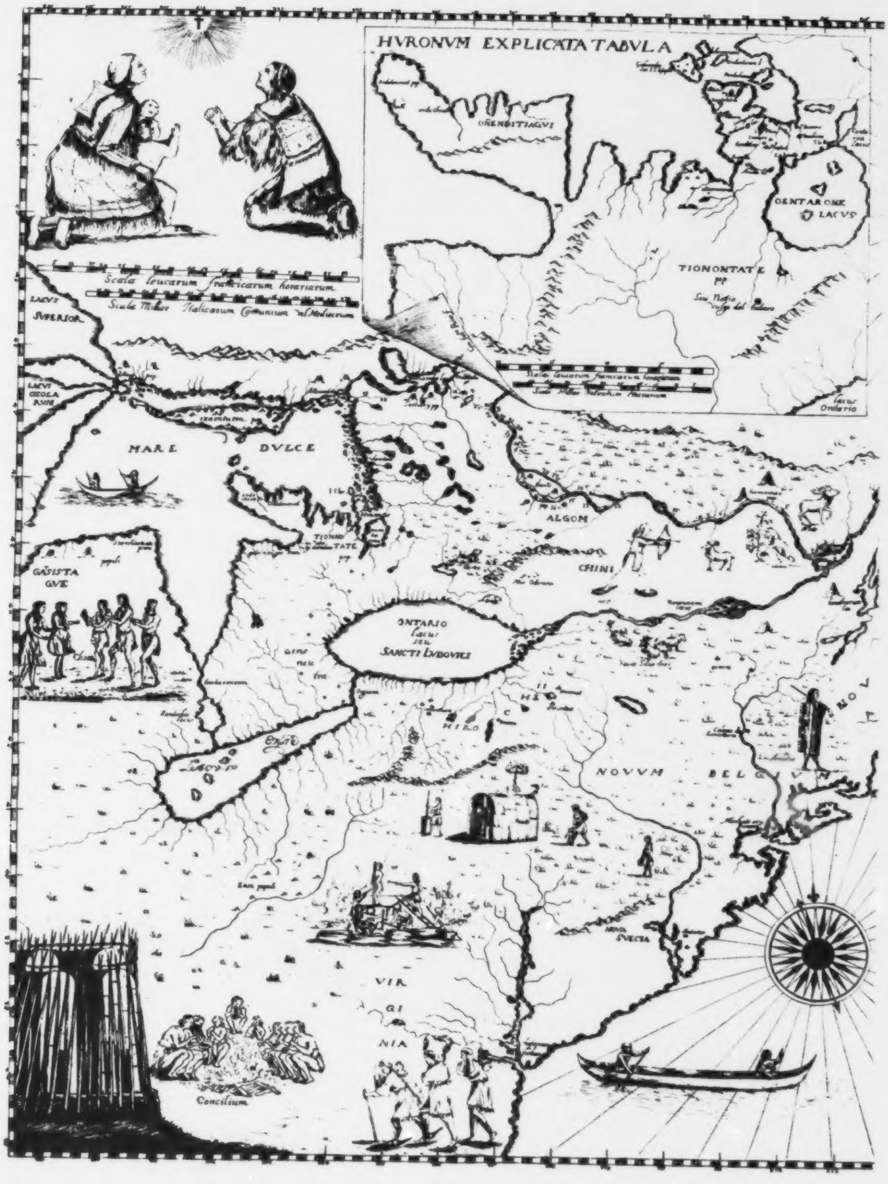
On November 17, 1623, a 14-foot roadway or ascent to Upper Town had been improved. It was built of branches, covered with earth, possibly the first wholly man-built highway to be constructed in Canada. It was rendered unserviceable by a fire later on in the century and the inhabitants widened it by six feet. On July 16, 1665, a French ship brought 12 horses to Quebec.[8] It is altogether likely that soon after the arrival of these mounts for military personnel, the public thoroughfare ceased to be a preserve for pedestrians only.

In 1609 Champlain made his fateful decision to take sides in the Indian inter-tribal wars, casting his lot and the lot of the French in America with the Algonquins and the Hurons against the Iroquois. It was also in that year that he made his first penetration of the interior of the continent. In 1610 he sent the youthful Étienne Brulé on an exploratory probe survey with Indians up the Ottawa River. Brulé, in all likelihood, was the first white man to gaze upon Rideau Falls at the place where the river of that name drops into the Ottawa. From this natural attraction Brulé made his way to the shores of Lake Huron on Georgian Bay by way of Lake Nipissing and the French River, the names by which all these waters are now known. In 1611 Champlain established a port on the site of what is now Montreal.

Champlain provided great new impetus to the mapping of Canada. As we have observed, Champlain had the benefit of the revolutionary advances in map making in the 16th century in Europe. He possessed not only a more ample knowledge than his pioneering predecessors but better instruments and improved techniques. The topographical data contributed by Champlain, and others after him in the fields of exploration, were splendidly correlated and mapped by such famous Paris geographers as Sanson, Delisle, D'Anville and Bellin. With Champlain began an era of new development in the cartography of eastern Canada.

In 1613 a publication appeared in France entitled, "Les Voyages du Sieur de Champlain Xaintongeois, Capitaine pour le Roy en la Marine". This volume contained an ode to Champlain, verses in praise of his books and of his marine maps. The ode was signed by Motin. In the book two large maps of New France conveyed a fair idea of the lay of the new land, though the portrayal fell considerably short of complete accuracy. For his achievements Louis XIII honored Champlain with a lieutenancy. The Brouage voyageur, happy over this royal recognition, sailed from France for Canada on March 6, 1613.

In New France Champlain was on the move again, as restless and as curious as ever. He left the Island of Ste. Hélène on May 27, 1613, with four French companions and one Indian. Delayed by miserable weather conditions he did not leave Sault St.


HVRONVM EXPLICATA TABVLA
OÑENDITIAGVI
OENTARONK LACVS
TIONONTATE pp
Scala leucarum francicarum horariarum
Scala Miliar Italicarum Communium vel Mediocrium
LACVS SVPERIOR
LACVS OLEOLA RVM
MARE DVLCE
TIONONTATE pp
ALGOM
CHINI
GAŠISTA GVE
ONTARIO Lacus seu SANCTI LVDOVICI
NOVVM BELGIVM
NOVA SVECIA
VIR GI NIA
Concilium

MAP 12. Western half of *Novae Franciae accurata Delineatio*, 1657; probably drawn by the Jesuit, Francesco Bressani. Courtesy of the Public Archives of Canada.

Louis until two days later. On May 30th he took observations for latitude at Lachine.

"Je prins la hauteur de ce lieu, qui est par les 45 degrez 18 minutes de latitude". ("I located the position of the place at 45 degrees, 18 minutes latitude.") This was only about five minutes less than the true latitude of the place. For those times such a result indicates a relatively minor error, particularly since there were no verniers marked on his instruments as there are nowadays, for reading in subdivisions of degrees. True verniers had been invented but were not then in common use. On June 4th, ascending the Ottawa River, Champlain took observations for latitude at what is now Hull, opposite Ottawa. "Je prins la hauteur du lieu et trouvay 45 degrés 38 minutes de latitude". ("I located the position of the place at 45 degrees, 38 minutes latitude.") This result was only 12¼ minutes in excess of the true latitude—45 degrees, 25 minutes, 33 seconds.

At Cheneaux Rapids Champlain crossed over to the west side of the Ottawa River and portaged south by way of Muskrat Portage and Muskrat Lake to what is now known as the vicinity of Renfrew. "Nous traversames donc à l'ouest la riviere qui couroit au nord et pris la hauteur de ce lieu que estoit par 46-⅔ de latitude. . . ." This is an error of a full degree, even allowing for the usual adjustment for the relatively imperfect instrument he employed. The true position is 45 degrees, 35 minutes. This, apparently, was Champlain's final observation prior to losing his astrolabe. In his diary he mentions that his companions were heavily loaded and "more harassed by the mosquitoes than by their burdens". He refers to a rest stop and to building a "fire to drive away the mosquitoes".

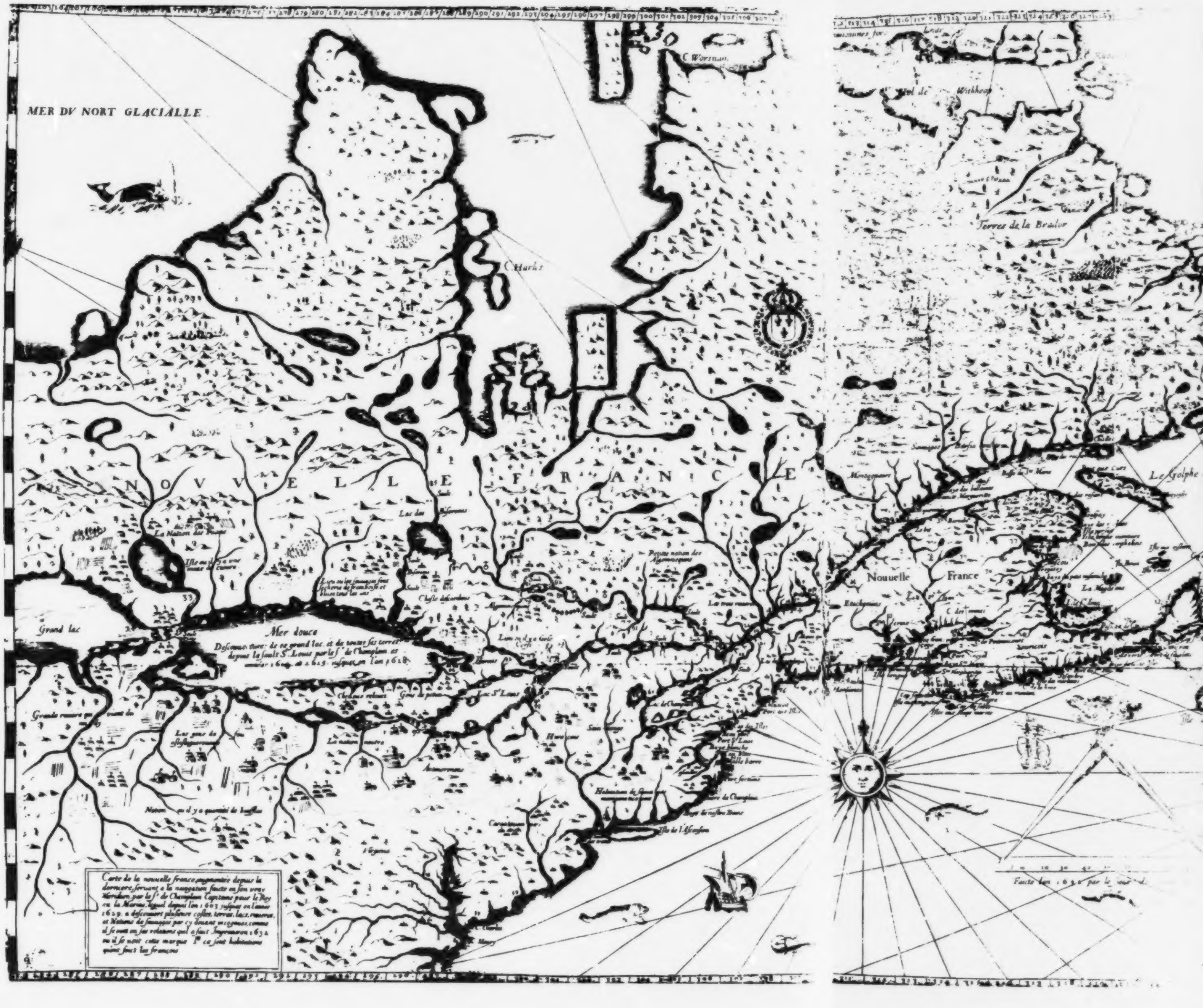
Champlain's rather serious error on his final reading took place below Portage du Fort. His journal contains evidence that he lost his astrolabe on either June 6th or 7th, 1613. Without his useful instrument he made no further observations for latitude on that journey.

In 1867 on the rear half of lot Number 12 in the second range of the township of Ross (North Renfrew County) near the road from Ottawa to Muskrat Lake an ancient astrolabe was found, believed to be that lost by Champlain 254 years earlier. The instrument was found by employees of the Ottawa Forwarding Company while cultivating a plot of ground under the supervision of Captain Overman. The astrolabe was of plate brass very dark with age. It was one-eighth of an inch thick at the top of the instrument increasing to six-sixteenths of an inch below. Probably this shape was designed to give the astrolabe greater stability, especially for use aboard ship.

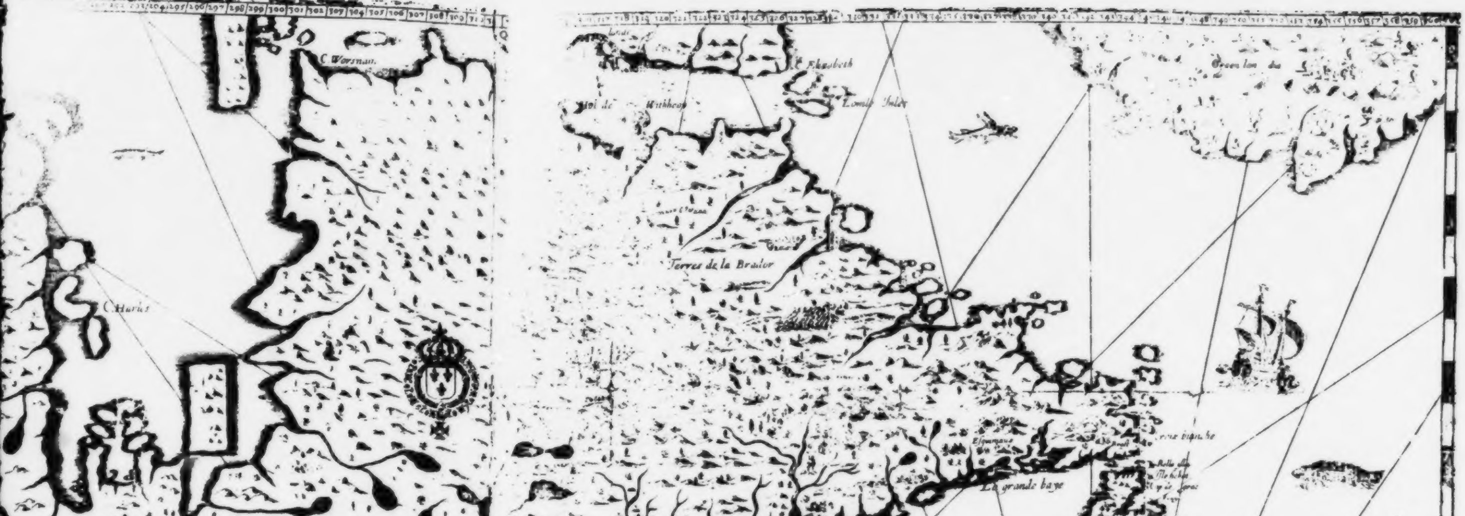
The recovered instrument had a suspension ring at the top, attached by a double hinge, suggesting a sort of universal arrangement. Its circular form was divided into single degrees graduated from its perpendicular axis of suspension. By turning the double-bladed index directly into the sun at noon so that the same ray might shine fully through both eyelets while the astrolabe hung freely, the sun's meridian altitude could be taken and thereby the latitude of the position fixed to within one-quarter of a degree or less. This was as accurate as any of Champlain's observed latitudes.

The date 1603 is engraved on the face of the astrolabe. This was probably one of the very last of such instruments to be put to actual use.

In 1615 Samuel de Champlain brought four Récollet missionaries to Canada from France and set forth with French companions and Indian friends on yet another journey into the interior. He was still intent on seeking the elusive western sea that would lead Europeans on to Cathay with all its glittering prizes and rewards. He little knew that he was travelling a part of the world which, in the long future, would produce wealth rivalling that of the fabled Orient.


MER DV NORT GLACIALLE
C Worsnam
C Harles
Terres de la Brador
N O V V E L L E F R A N C E
La Nation des Puans
Lac des Bisserins
Grand lac
Mer douce
Descouuerture de ce grand lac et de toutes ses terres depuis le sault S.t Louis par le S.r de Champlain es années 1603 et 1615 jusques en l'an 1618
Lac S.t Louis
Nouuelle France
Le Golphe
Les Antouoronons
Carte de la nouuelle france augmentée depuis la derniere, seruant a la nauigation faicte en son vray Meridien par le S.r de Champlain Capitaine pour le Roy en la Marine, lequel depuis l'an 1603 jusques en l'année 1629, a descouuert plusieurs costes, terres, lacs, riuieres, et Nations de sauuages par cy deuant incognues, comme il se voit en ses relations qu'il a faict Imprimer en 1632 ou il se voit cette marque ⚐ ce sont habitations qu'ont faict les françois
Faicte l'an 1632 par le

MAP 13. Champlain's map of 163 ourtesy of the Public Archives of Canada


Terres de la Brador
La grande baye
Le Golphe St Laurens
Terre neuve
Nouvelle France
F R A N C E
Le grand banc
Isle de sable
Isle de l'Assomption

MAP 13. Champlain's map of 1632. Courtesy of the Public Archives of Canada

At one stage the French surge in the New World looked bright. The principal motivating drive supporting French colonization efforts was the desire to convert natives to Christianity. But closely connected with this primary motive was the economic factor. The Jesuit mission to the Hurons seemed to open for a time the way to French settlement of the lands extending from Quebec to the southwestern end of what is now Lake Erie and possibly beyond that area into the whole of the Mississippi basin. There was, however, one formidable impediment, namely, the ferocity of Iroquois resistance. The Iroquois confederacy had become allied with the Dutch and English to the south and east. In association with superior English sea power the flanks of the French-controlled region were continuously harassed and steadily compressed. Even their access to Hudson Bay was restricted. The internal lines of French continental communications were often endangered. By the end of the 18th century British settlements in North America consisted mainly of farmers whereas at that time the population of New France consisted for the most part of soldiers, priests, hunters and fur traders.

But it should be borne in mind always that long before the United States, as such, came into being, Canada existed as a cohesive entity on the fertile strip between Quebec and Montreal. In that area there had developed by the middle of the eighteenth century a spirit and a tradition that prevented New France from being absorbed by the more powerful and more rapidly expanding neighbor to the south.[9]

Thus is was that in the summer and autumn of 1615 Champlain was unwittingly preparing permanent limitations upon French sovereignty while at the same time opening up new country to the exercise of French influence and control. In that year he crossed Lake Nipissing and descended the French River to Georgian Bay on Lake Huron. In the Cataraqui (Kingston) area in the same year Champlain and a party of French companions spent some 38 days hunting, fishing and exploring, the first appearance of white men in that region.[10]

In the autumn of 1615, while Champlain was plunging into Indian territory to the south, Snellius, thousands of miles away in the Netherlands, was carrying out the first exercise in practical triangulation. In this foray Champlain accompanied a Huron war party to map rich lands to the south. However, in a brisk encounter with their Indian foes he was wounded in the knee by a stray arrow. The return journey to Cataraqui was an agonizing one and was accomplished on a warrior's back in a makeshift wicker arrangement. But with enforced rest Champlain recovered sufficiently to enable the party to cross Lake Ontario by way of what is now known as Wolfe Island. They landed somewhere near the present site of Kingston.[11]

In 1626 the first missionary members of the Society of Jesus arrived at Quebec and on April 6th the Jesuit Convent was completed. Three years previously the Society had been granted one of the first three seigniory concessions in Canada, that of Notre-Dame-des-Anges. In the following year the Company of One Hundred Associates was formed. But in this same period matters of some moment were afoot across the Atlantic. By letters patent Charles I of England had empowered the Kirke brothers, Louis and David, to trade with America and to seize any Spanish or French vessels as well as to destroy the forts of New France. In 1629 Quebec capitulated to the Kirke fleet.

Technically Champlain was a prisoner of war when he sailed from Quebec with the English invaders bound for London. But he was allowed to discard the role of prisoner for that of a diplomat. He visited the French ambassador in London and laid before him the Canadian case for development, with a copy of the treaty of capitulation and a map of New France as far as it had been explored. According to Champlain, "This part of America which extends to the Arctic pole northward is called New France because Jean Verrazzano, a Florentine, having been sent by King François first to these quarters, discovered nearly all the coast, beginning from the Tropic of Cancer to the 50th degree and still more northerly, arboring (displaying) arms and flags of France; and for that reason the said country is called New France". Champlain, in pressing the issue, even made visits to Paris. Louis XIII was suitably impressed and demanded from England restoration to France of the fort at Quebec and the forts on the Acadian coast which, in His Majesty's view, had been captured after the signing of the peace between England and France. Mainly for fiscal reasons Charles I of England finally yielded to the French position and the restoration was agreed upon.

In 1632 Champlain published in Paris the volume entitled, "Les Voyages de la Nouvelle France Occidentale dicte Canada faits par le S^r de Champlain . . . depuis l'an 1603 jusques en l'an 1629". ("Trips in Western New France named Canada by the Sieur de Champlain. . . . from the year 1603 to the year 1629.") This book, his last, contained his most famous map. In the same year Father Le Jeune commenced writing the Jesuit Relations. Only the previous year a Frenchman, Pierre Vernier (c.1580-1637) published at Brussels a treatise in which the instrument associated with his name was described. This measuring device invented by Vernier permits the reading of linear or angular magnitudes with much greater accuracy than had been possible with any scale as then divided and subdivided. The invention was based on the principle that the eye can more closely determine when two lines coincide than it can establish the distance between two parallel lines.[12]

When, on July 13, 1632, the flag of France was seen by the inhabitants of Quebec, its whiteness floating above a vessel entering the harbor, they rejoiced exceedingly. For their good fortune they owed more than they could realize to Champlain. Mass was celebrated in the home of Madame Hébert for the first time in three years. In the interval, under English domination, one child had been born, a daughter to the Guillaume Couillards. But no death was recorded save the murder of an Iroquois prisoner by a drunken Montagnais.[13]

In June, 1633, with experience in successful Old World diplomacy as another badge of accomplishment, Champlain returned to Quebec as the first Governor of New France. In the New World, in the land he loved and in which he had fulfilled himself, his days were now numbered. He had little more than two years of reasonably good health remaining in which to complete his life work. In 1634 several developments of significance to the growth of surveying and mapping in Canada took place. In that year a settlement was founded at Three Rivers by La Violette. In the same year also one Robert Giffard obtained a tract of land from the Company of New France, a tract one league in depth and a league and a half in breadth. It was situated between the rivers Montmorency and Beauport, bounded in front by the River St. Lawrence and at the rear by the Laurentian hills. Also granted as a special favor were two acres situated near the fort for the erection of a residence with suitable grounds.

It was on August 8th, also in 1634, that a remarkable man arrived at Quebec from France, namely, Jean Bourdon then 33 years of age. This man was destined to become the "engineer and surveyor general of the colony — *ingénieur et arpenteur-général de la colonie*". Jean Bourdon was a man of unusual capacity who became, in turn, surveyor, engineer, cartographer, farmer, diplomat and lawyer in his new environment. In all, Bourdon served under eight governors — Champlain, Montmagny, Ailleboust, Lauzon, Argenson, Avaugour, Mézy and Courcelles.

Soon after his arrival at Quebec young Bourdon was called upon to prove his ability as a diplomat. Champlain had been accustomed to the assumed status of self-made engineer-in-chief of the colony. Bourdon was now obliged to watch his own actions with care. Wisely he made application to Champlain for his plot of land and for permission to build. He chose to erect his habitation on high ground later to be known as Sainte-Geneviève.

In Champlain's period of service in New France there were in vogue three methods of carrying out surveys. Firstly, there was the use within settlements of compass and reference marks. Secondly, there was the use of telescope with compass and thirdly, the use of a wheel for the measurements of distances. It is interesting in this connection to note how Champlain instructs the surveyors of New France in the matter of drawing a meridian.

"Take a very well shaved small plank," he writes, "and in the middle fix a needle C three inches high, in an upright position. Expose on a sunny day in the morning at 8 or 9 o'clock. Mark the spot where the shadow of the needle C will fall. With a compass opened with one point on C and the other on shadow B, draw a semicircle AB. Leave all until the afternoon, when you will note the shadow falling on A. Thus, having determined the semicircle AB, apply a ruler on points A and D and draw a line as long as the small plank which remains firmly fixed in one position. CD will be the meridian of the region."[14]

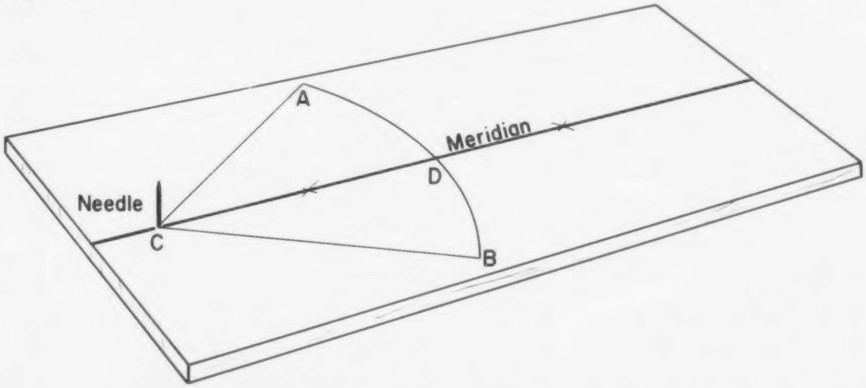


FIGURE 7. From *Works of Champlain*, ed. Charles Laverdière, v. 3, 1870.

To determine the local compass deviation from the meridian Champlain advised surveyors to set a sundial along the meridian as in the following diagram:
At the bottom of the sundial is a circle divided into 360 degrees. The circle is to be divided by two diameters, one giving the North section and South section, as shown by EF and the second, giving East and West sections by GH. Then observe the pointer which rests on a pin and note the direction of the deviation from the fixed meridian which is at the bottom of the sundial and note the number of degrees it moves to the northeast and to the northwest.

The earliest explorers in New France were skilled navigators so that the earliest surveys were those of rivers and lakes, the waterways into the mysterious interior. Explorers traced their travel routes on self-made maps. Survey operations in those formative times consisted for the most part of daily determinations of the the explorer's position, using astronomical measurements and compiling rough field notes.

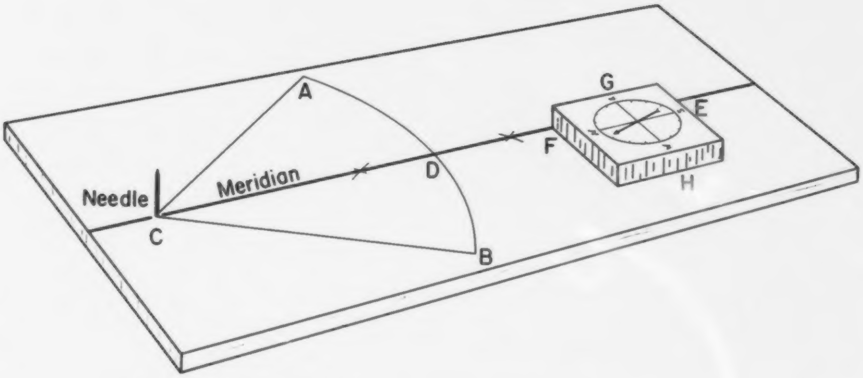


FIGURE 8. From *Works of Champlain*, ed. Charles Laverdière, v. 3, 1870.

The year 1635 was a particularly difficult one for the little colony. Supply ships from France were greatly delayed en route by rough weather and then by icebergs. In the early autumn, just two weeks after the last of the outgoing ships had left Quebec, Champlain, now aged 68, suffered a severe stroke. He failed to recover, lost ground steadily and passed away on Christmas Day.

Explorer, navigator, soldier, mapper, colonizer, surveyor, commander, author and administrator, Samuel de Champlain in the space of a quarter-century made an enduring contribution to the building of Canada. He was outstanding among that succession of men of special ability, courage and high resolve who served France and New France so well during the 17th century. Most of these men were inspired by a profound devotion to their motherland as well as by the lure of the unknown. Their vision of a French empire in America was mightier than that held by monarchs and court officials in Europe, authorities who often failed to provide deserved support of their ambitious undertakings.

Today in Canada Champlain's deeds and continuing influence are commemorated in names of rivers, lakes, mountains, towns and counties, as well as by many city streets and buildings. Important monuments at Quebec, Ottawa and Orillia, Ontario, perpetuate his fame. The Champlain Society is dedicated to the encouragement of Canadian historical works of excellence.

What then, in summary, can be justly said of the contribution by Champlain to the mapping of Canada? To some extent his earliest journeys in New France covered places Cartier had visited seventy years earlier. But Champlain's surveys were more exact and more thorough-going. He made more careful observations of harbors and penetrated the interior along St. Lawrence River tributaries quite unknown to Cartier.

Before arriving in any official capacity in the St. Lawrence area Samuel de Champlain had occupied himself during three summers in tracing more than one thousand miles of the Atlantic seacoast, including the Bay of Fundy, the shores of Nova Scotia and New Brunswick as well as those of New England. In the intervening winters he worked on the production of a general chart of the entire region he had travelled. His local and general maps were not the result of elaborate surveying techniques. He lacked precision instruments and his measurements were often inaccurate. Nevertheless his maps are creditable examples of the cartography of his day and generation. They

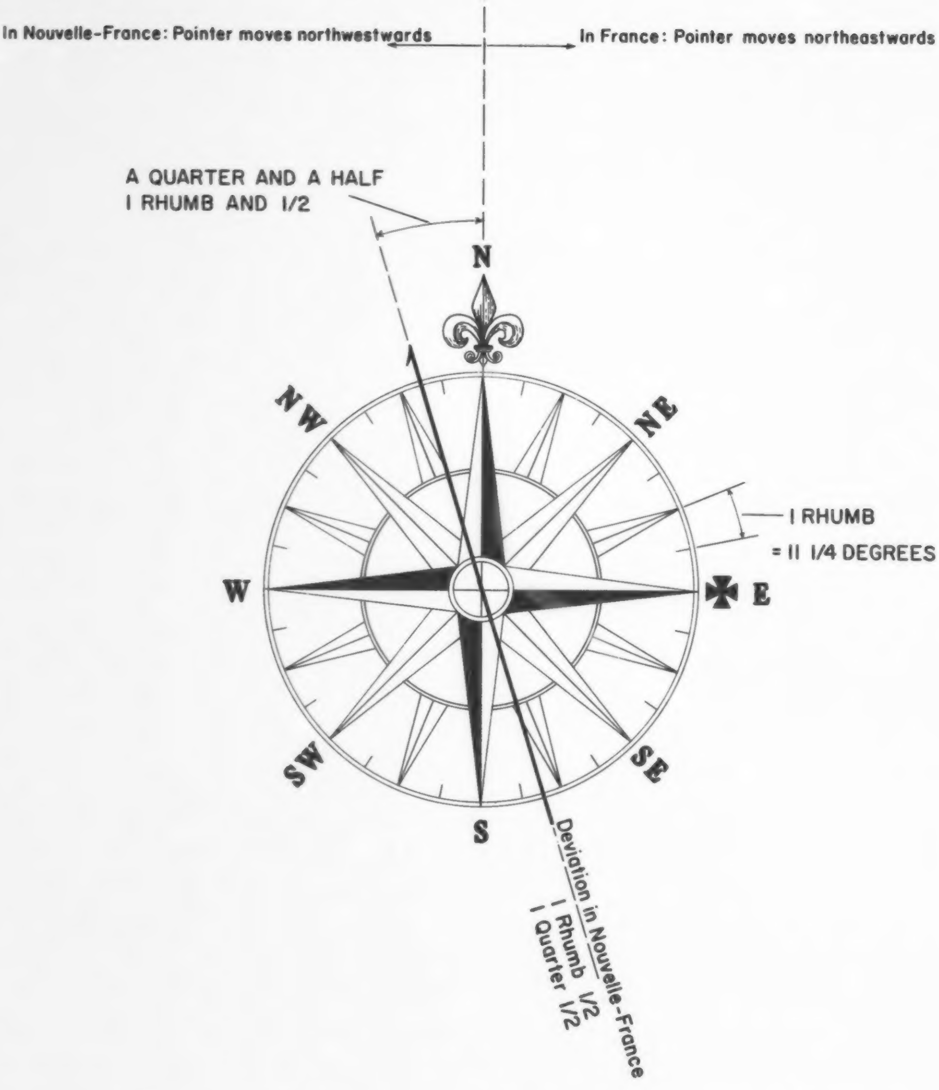
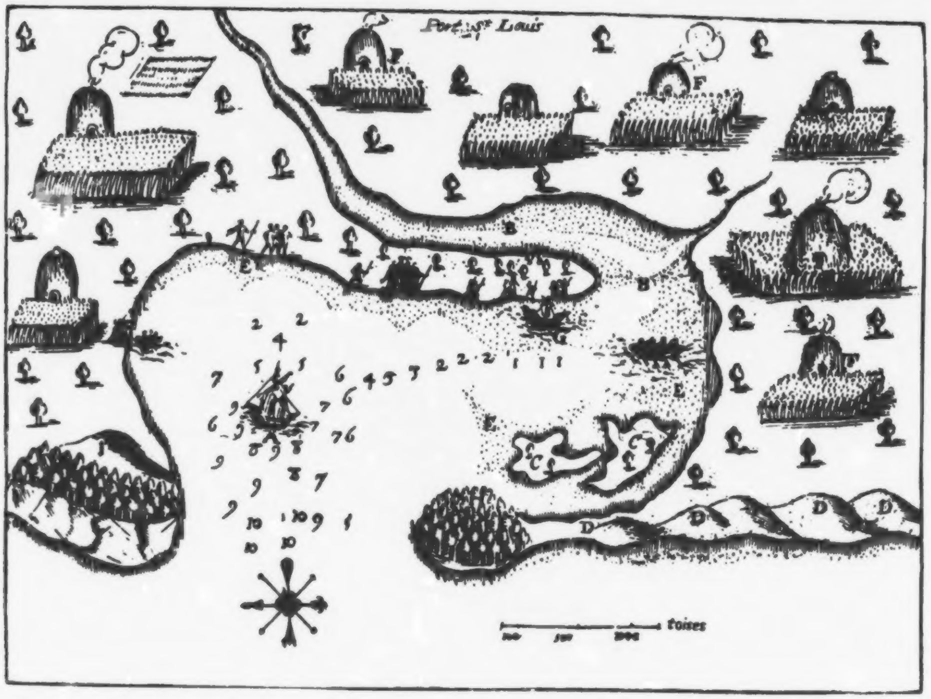

In Nouvelle-France: Pointer moves northwestwards
In France: Pointer moves northeastwards
A QUARTER AND A HALF
1 RHUMB AND 1/2
N
NW
NE
1 RHUMB
= 11 1/4 DEGREES
W
E
SW
SE
S
Deviation in Nouvelle-France
1 Rhumb 1/2
1 Quarter 1/2

FIGURE 9. Compass Deviation in New France as Ascertained by Champlain. From *Works of Champlain*, ed. Charles Laverdière, v. 3, 1870.



MAP 14. Port St. Louis (Plymouth, Mass.) by Samuel de Champlain. From: *Les Voyages du Sieur de Champlain,* Paris, 1613. Courtesy of the Public Archives of Canada.

reveal a good grasp of mapping essentials and display a marked skill. His descriptions of the native people, the nature of the Canadian land and soil as well as of its natural products and resources are clear and well-defined. These writings could, in fact, be regarded as worthy prototypes of the reports to be made in the long future by Canadian surveyors, particularly in the latter part of the 19th century at a time when the prairie West was being prepared for extensive settlement.

Before leaving the Atlantic coast Champlain made a number of plans and sketches. In his "Voyages du Sieur de Champlain, Xaintongeois, Capitaine pour le Roy en la marine . . . ." published in 1613, some 22 of his maps and drawings are included along with a large map made in 1607, covering the territory he had personally surveyed. This latter map was the first to delineate the coastline of Acadia and New England with any considerable degree of accuracy. There was also included a geographical map, "carte geographique de la Nouvelle France en son vray meridian . . .", the first genuine attempt to lay down latitudes and longitudes on the Atlantic coast of North America. It might well be said of Champlain's cartography of this period that it marks the genesis of sectional mapping in Canada.

Two of Champlain's maps have not yet come to light — the map he claimed to have made in 1603, drawn to show King Henry IV the extent of his New World discoveries, and a map made for de Monts resulting from voyages made from May, 1604 to September, 1607. In addition there are several examples of his handiwork that do not lend themselves to classification. There is his chart of the St. Lawrence from the mouth of the Saguenay River to Quebec, with information from soundings. There is his sketch of the Long Sault near Montreal Island. This is not based on surveys in the modern sense of the term but is constructed, rather, from compass-aided sketches. There is also in existence Champlain's 1608 sketch of Tadoussac, published in 1613, including harbor soundings, and there is a plan of Quebec contained in his 1613 volume.[15] A map made by Champlain in 1616 has been found in recent years and shows the Great Lakes, as then comprehended, in rather crude outline. Hudson Bay appears in somewhat distorted form. But Nova Scotia and the Gulf of St. Lawrence are fairly well represented, even by the stricter standards of much later times. Although in some respects it is a copy of his 1613 product, the 1616 map illuminates the important stage in a slowly developing fund of European knowledge of New France in the first half of the 17th century. But Champlain's principal reputation as a cartographer must rest mainly on his major and best known map, published in 1632 in the fourth and last of his printed works.

The cartographic work of Champlain marks the transition in North America from a more or less speculative type of topographical mapping to maps based upon first-hand surveys by the mapper. In this respect the Brouage voyageur opened a new era in Canadian cartography. It is fair to say that Champlain was a true pioneer of modern geography in its application to the important parts of Canada he explored.

Champlain is rightly regarded as the Father of New France and a pioneer of civilized society in Canada. He lives on in the hearts and minds of Canadians not only as a daring explorer but as the revered founder of the most ancient of its cities. "Champlain, nom historique, nom symbolique de courage, de force et d'intrépidité, mais également nom qui a sa place dans les origines d'une profession qu'il a aimée et qui lui a permis de dresser les premières cartes que l'on possède de la Nouvelle-France. Les manuels d'histoire le désignent comme le père de la Nouvelle-France, mais, c'est à juste titre également que nous le reconnaissons comme le père des arpenteurs-géomètres du Canada. En effet, non seulement il fut un navigateur d'élite, mais un distingué cartographe".[16]

"Champlain, this historic name, symbol of courage, strength and fearlessness but also a name which appears in the birth of a profession he has cherished and through which he drew up the very first map known today of New France. History texts relate that he is the Father of New France but equally we recognize him as the father of land surveyors of Canada. Indeed he was not only an eminent navigator but also a distinguished map maker."

High on a promontory near Parliament Hill in Ottawa Champlain takes permanent sight for latitude with his now-famous astrolabe, a symbol in bronze of the explorer, surveyor, mapper and man of vision.

Table of Lineal Measurements
(New France)

1 Pouce	— 1.0666 inches	
12 Pouces	— 1 Pied	— 12.789 inches
6 Pieds	— 1 Toise	— 6.395 feet
3 Toises	— 1 Perche	— 19.184 feet
10 Perches	— 1 Arpent	— 191.838 feet
84 Arpents	— 1 League	— 3.052 miles

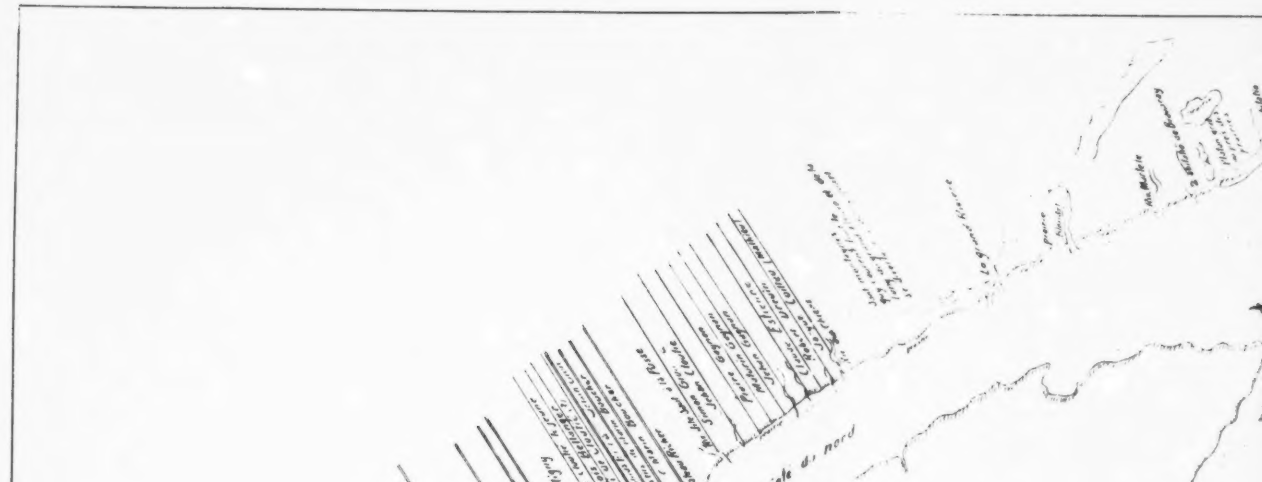
7

NURSERY FOR NAVIGATORS

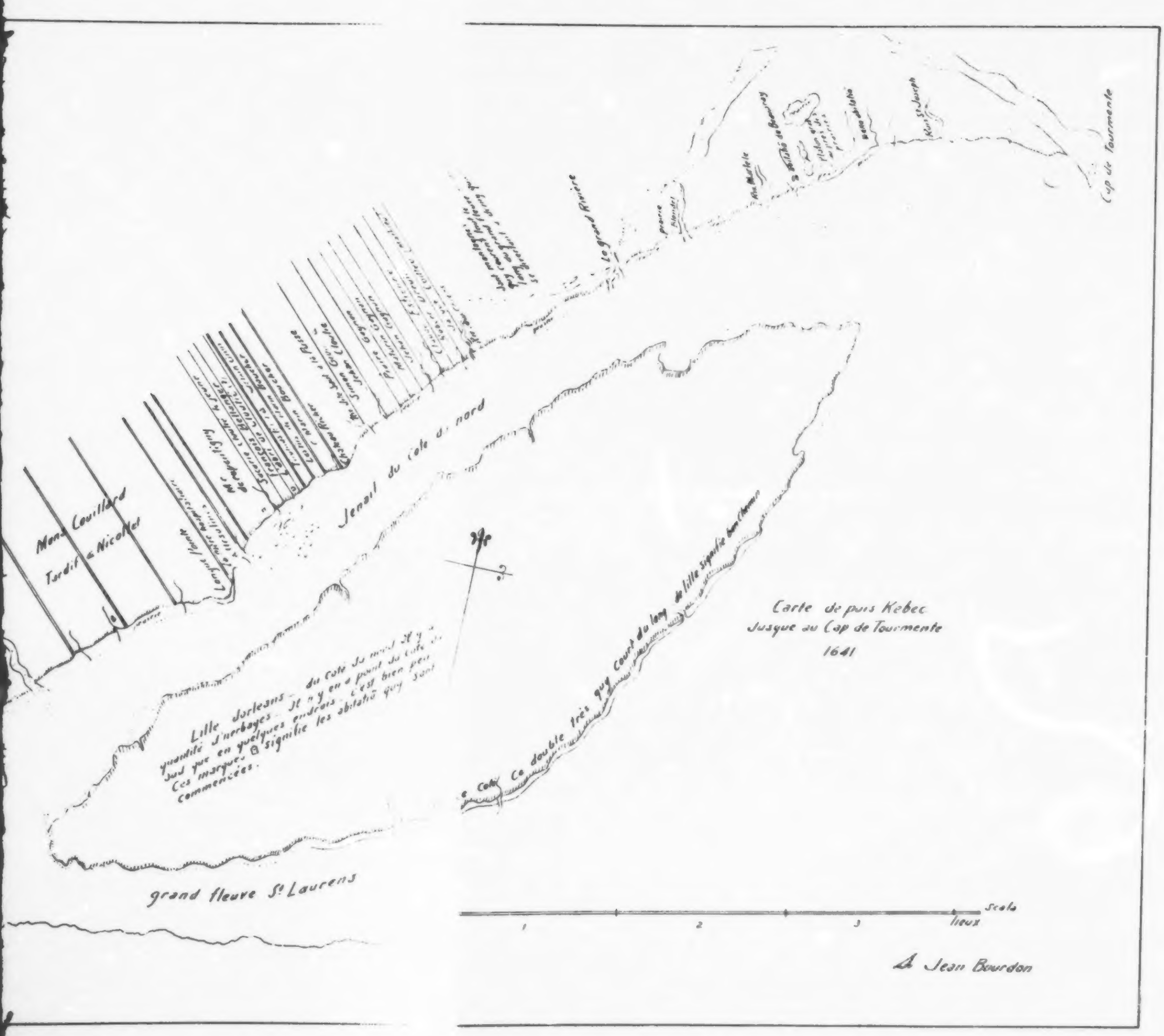
On the arrival of Governor de Montmagny at Quebec, Jean Bourdon received swift official recognition. He emerged with alacrity from under the dominating influence of Champlain's work and reputation and was at once plunged into a period of intense activity and new responsibilities. Bourdon, described by some historians as "Canada's first engineer", was born at Rouen in 1601. That was the year when Fermat, destined to become an eminent mathematician of France, first saw the light of day. The previous year had witnessed the birth of Nicolas Sanson who, in his day, became a celebrated cartographer and initiated, about 1650, a world-famous school of French geographers.[1]

Bourdon, already in good repute as an expert surveyor and a wise engineer, came to Canada as Engineer of the Company of New France. This organization was the creation of Richelieu, made Cardinal in September of 1622. Two years later Cardinal Richelieu became chief minister to Louis XIII. For the next eighteen years the pale-faced, iron-willed cardinal worked to make the royal power of France absolute at home and supreme in continental Europe. By the formation of the new company, more widely known as the Company of One Hundred Associates, Cardinal Richelieu hoped to extend the power of France in America. But the Kirke brothers, under the flag of England, entertained other ideas and neatly intercepted the company's fleet as it entered the St. Lawrence River in 1628. It was a spectacular seizure of company-chartered vessels as well as of hundreds of immigrants and large quantities of stores intended for the colony at Quebec.

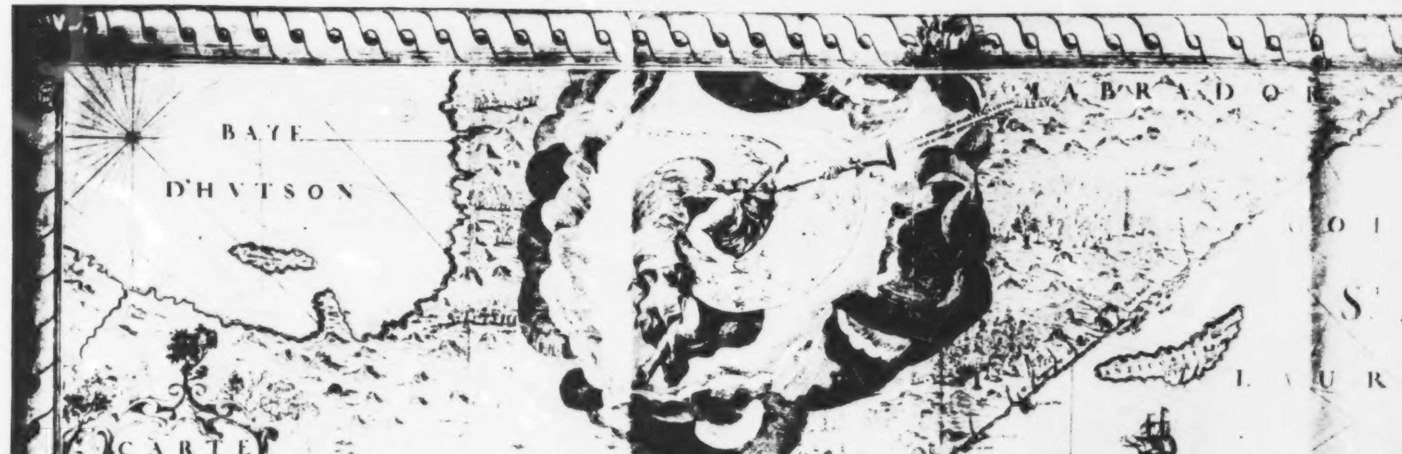
Following Champlain's persistent diplomacy, given impetus by the fiscal needs of the royal treasury of England, the treaty of St. Germain-en-Laye was concluded between France and England in 1632. Under its terms the New World possessions of the French were restored to them. The Company of New France had almost been ruined by the action of the Kirke brothers and by other calamities but now experienced a pronounced


Carte de p
Jusque au Cap
1641
grand fleuve St Laurens
Lille dorleans du coté du nord Il y a quantité d'herbages. Il n'y en a point du coté du sud que en quelques endroits. C'est bien peu. Ces marques ◻ signifie les abitatiõ quy sont commencées.
Jenail du coté du nord
Mons Couillard
Tardif & Nicollet
Sault de Montmorency
quebec
Cap de Levi
Les Peres Jesuites
Simon Guyon
Jean Guyon
Mathurin Gagnon
Jean Gagnon
le grand Riviere
2

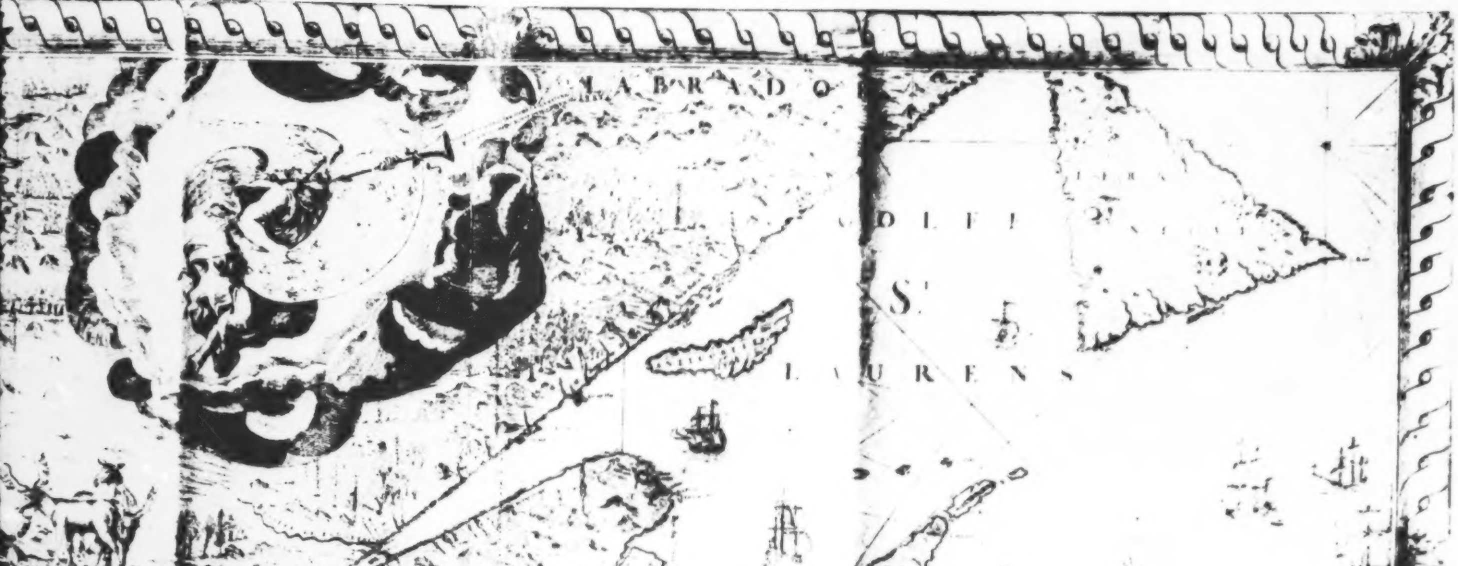
MAP 15. "Carte depuis Kébec jusques au Cap du Tourmentes" 1641 by Jean B· original is in the Bibliothèque Nationale, Pa
from a copy in the Public Archives of Canada.


Mons Couillard
Tardif & Nicollet
Jenail du Cote du nord
Le grand Riviere
Cap de Tourmente
Riv. St Joseph
Lille dorleans — du Cote du nord Il y a quantite d'herbages. Il n'y en a point du Cote du Sud que en quelques endrois. C'est bien peu
Ces marques ⌂ signifie les abitatiō quy sont commencées.
Ce double très quy court du long de lille signifie bon Chemin
Carte de puis Kebec
Jusque au Cap de Tourmente
1641
grand fleuve St Laurens
Scala
1
2
3
lieux
Jean Bourdon

depuis Kébec jusques au Cap du Tourmentes" 1641 ourdon. The original is in the Bibliothèque Nationale, Paris. Reproduced
he Public Archives of Canada.


BAYE
D'HVTSON
LABRADOR
CARTE
LAC ONTARIO

MAP 16. "Carte pour servir à l'éclaircissement du Papier Terrier de la Nouvelle France" by J. B. L. Franquelin, 1678. The original is
Nationale, Paris. Reproduced from a copy in the Public Archives of Canada.


L A B R A D O
G O L F E
S.T
L A U R E N S

rte pour servir à l'éclaircissement du Papier Terrier de la Nouvelle France" by J. B. L. Franquelin, 1678. The original is in the Bibliothèque
ris. Reproduced from a copy in the Public Archives of Canada.

revival. This resurrection was the beginning of a period when the Society of Jesus as well as the Company provided the principal guidance and leadership of colony affairs.

In 1632 also, the Jesuit Superior at Quebec, Father Le Jeune, began writing the Jesuit Relations. This publication was designed to keep the people of France informed of conditions in the colony and to help attract stronger support for the work of the Jesuits from the State as well as from private benefactors. In addition the Relations provided a useful means of advocating increased settlement of French people in Canada, its propaganda in this regard being directed to that large part of the home population, the people of "moderate means". It was at this stage in the colony's development that first signs of what is now known as town planning appeared in Canada. "The outlines of a town are being drawn up in order that future building shall be done systematically," wrote Father Le Jeune in the Jesuit Relations.[2] The location of buildings and the boundaries of land grants at the time were made subject, by order of the Governor, to Jean Bourdon's approval.

During the months he spent under Champlain's government Bourdon had felt impelled to function discreetly, but under Montmagny he was given much freer rein to exercise his undoubted engineering and surveying talents. The change in governorship resulted, therefore, in a drastic upsurge in Bourdon's fortunes. He began to accompany Montmagny on official trips. One of his first actions in the Montmagny regime was to stake out the location of a new fort at Quebec.[3]

Following the summer's activity in 1636 Montmagny and Bourdon travelled to the mouth of the Richelieu River. A survey was made there before they proceeded to the island of Montreal and as far as the Lachine Rapids. After returning to Quebec they made a visit to Beaupré. During these travels Bourdon accumulated information for his 1641 map of the St. Lawrence coastline from Quebec to Beaupré.[4]

In succeeding years Bourdon functioned in the combined roles of engineer, surveyor and public works supervisor. In addition, as a town planner, he had an ambitious concept of the future of Quebec as a city. He laid out on paper various streets. In fact, one of the first projects of the new Governor was to prepare a city plan, after having attended to its fortifications, and to lay out new streets as well as to straighten or widen existing streets. The first mention of St. Louis Road occurs in 1637 and not until thirty years later was the St. Foy Road declared open. Action to improve the highways was by no means premature in the late 1630s. Roadways leading to the level of the Upper Town were made less hazardous. Neither Champlain nor the English occupiers (1629-1632) had done much, if anything, to improve the roads of the colony. Quebec streets, far from being paved, were more often than not made of branches, covered with earth.

Fear of the Iroquois was a dominant emotion in the colony at that time. The Five Nations were about to launch their last and greatest campaign of attack and terror. Montmagny was as desperate as the white colonists were alarmed. He despatched Bourdon to Paris to construct a map or maps portraying the military situation. Father Le Jeune accompanied him, stressing in high official quarters the military requirements for the safety and success of the Jesuit missions.

During that winter of 1641-42 spent in France, Jean Bourdon made at least one map, his "Carte depuis Kébec jusques au Cap du Tourmentes".[5] This was the first map of importance to be made of New France since Champlain's noteworthy efforts. It also served to show the expansion potential of the Quebec area. That same winter he made a second map, it is claimed, covering the area from Quebec to Montreal along the St. Lawrence.[6] It is possible that Bourdon's undated map, "Rivière St. Laurent depuis Montréal jusqu'à Tadoussac" was made at the time of this Paris visit also.

One year after Cardinal Richelieu's death in 1642, Louis XIII died and no military aid or funds were forthcoming from France for the struggling colony in Canada. Bourdon, in this time of great trial, won the esteem of colonists and the Jesuit fathers. On New Year's Day, 1646, the Superior at Quebec presented to him an instrument described as "a telescope mounted with a compass".[7] Hans Lippershey, with two associates in Holland, had invented the telescope in 1608, and in the year following Galileo had vastly improved its magnifying powers. It was a discovery that revolutionized surveying and mapping in the western world.

In 1646 Bourdon made a daring trip into Iroquois country in company with Father Isaac Jogues of the Jesuits. Montmagny had asked Bourdon to go on this peace-seeking mission in order to sketch a map of the Richelieu River. The Governor made sure that Bourdon carried with him a compass and quadrant. This journey, from its start at Three Rivers until the return to that point, occupied forty-four hazardous days. Father Isaac reported, "We made a fairly exact map of the country through which we passed". Bourdon commented, "The good Father was indefatigable". It is likely that Father Isaac, in his statement, had reference to field notes together with a rough sketch.[8]

The peace pact entered into between the emissaries and the Iroquois failed to last a full year. In 1647 there were raids on French settlements and in the following year Governor de Montmagny was replaced by Louis D'Ailleboust who continued in that office for three years. In 1650 Bourdon made the second of a total of four visits in his lifetime to France. On each of his visits to Paris Bourdon made maps of parts of the New World and it is likely during the winter of 1650-51 he made a map of the Richelieu River country through which Father Isaac and he had made such a dangerous journey a few years previously. In 1651 one Martin Boutet arrived in Canada from France, a man destined to play a significant part in the development of surveying and mapping in New France.

Bourdon's good relations with the governors of the colony continued under the regime of the successor of D'Ailleboust, namely, Jean de Lauzon, whose term extended from 1651 to 1657. Initially Bourdon had come to Canada under the patronage of Jean de Lauzon, at the time a director of the Company of New France. Over the years of his governorship there were several happenings closely linking the Lauzons and the Bourdons. Governor Lauzon attended the ceremony in Quebec in 1652 when Bourdon's oldest daughter, Geneviève, took the veil at the Ursuline Convent there.[9] Actually Geneviève Bourdon was the first Canadian Ursuline. Also, when Jean Bourdon, a widower, married again in 1655, the wedding took place in the private chapel of the Governor's residence in Fort St. Louis. The Governor and his son Charny were witnesses at the wedding ceremony.

In the spring of 1657 Bourdon was commissioned to find a sea route to Hudson Bay in the interests of trade with the natives. On May 2nd he sailed from Quebec in the *Petit Saint-Jean* with sixteen Frenchmen and two Hurons. Bourdon's expedition was reported in the Jesuit Relations.

"On August 11th M. Bourdon's bark appeared (having returned to Quebec). It had followed the northern shore of the great river (St. Lawrence) .... to the 55th degree (not far from Hamilton Inlet, Labrador)".[10] The expedition had turned back following an unprovoked Eskimo attack on the party resulting in the death of two Hurons and the interpreter. Without the services of the latter, Bourdon felt that the expedition could not succeed and turned back.

Bourdon was back again in France in 1660, the year of the founding of the Royal Society of England. He was in Europe to lend support to Governor d'Argenson's plea to the home authorities for greater military aid to the colony against the increasing Iroquois menace. While in Paris on this mission Bourdon made the acquaintance of a young student, Sebastien Vauban who, at 27 years of age, had hopes of becoming an ingénieur du roi. As matters turned out, he became a Maréchal de France. While in Paris Bourdon drew a plan of Quebec—"vray plan du haut et bas de Québec comme il est en l'an 1660".[11] In this same year the antecedents of Samuel Holland, Protestant refugees from the consequences of religious strife, which had tarnished the reigns of James I and Charles I, moved from England to the Netherlands. In later years Samuel's brilliant career in England and subsequently in America influenced profoundly the growth of surveying and mapping in Canada.

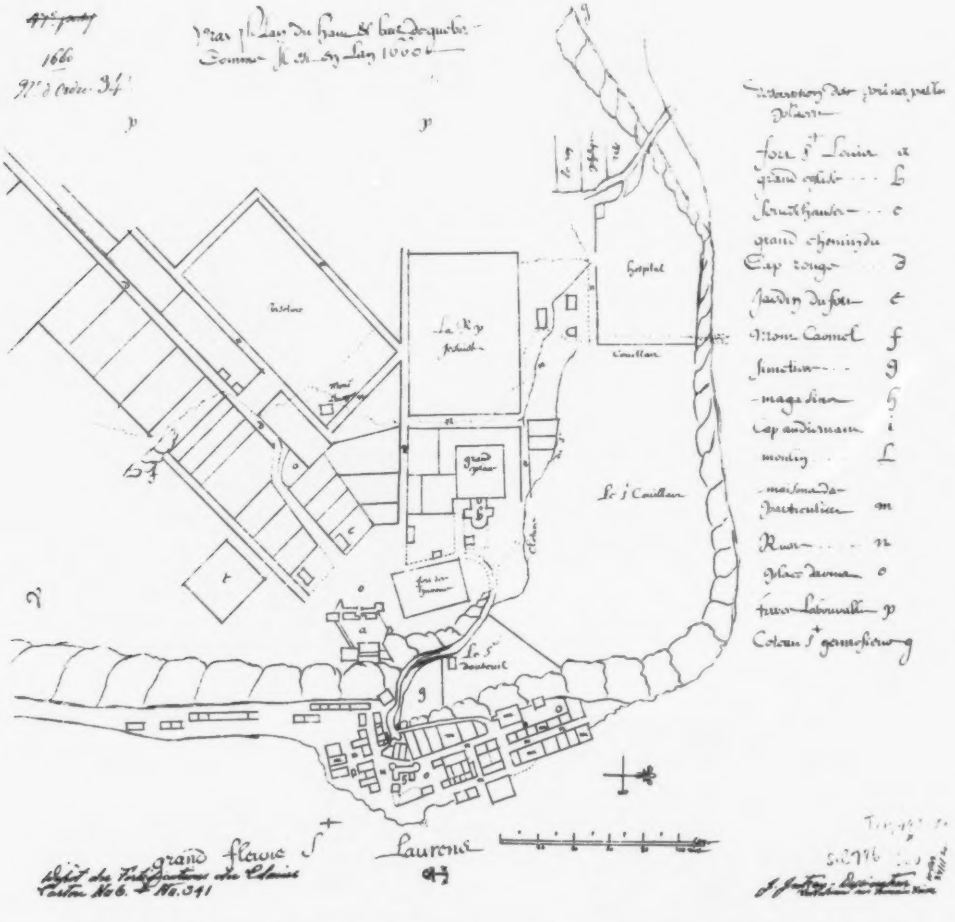
It was an eventful year in Canada as well. Dollard des Ormeaux and his sixteen French companions fought a gallant but losing fight against the Onondagas at the Big Sault, near present-day Hawkesbury, Ontario. This brave example may well have discouraged the Five Nations of the Iroquois from conducting a wholesale attack upon the settled parts of New France. Farther west the intrepid Jesuits were busily mapping Lake Superior. Closer to the centre of things, in the vicinity of Quebec, an embryo settlement was being established at Charlesbourg. But, on the whole, the colonizing efforts of the Company of New France had met with dismal failure. The company had promised to land at least 4,000 settlers by 1643. Actually the total white population in the Quebec area was little more than 300 at the time.

Some four years after his return to Canada Bourdon's ability to maintain good relations with the governors of New France finally deserted him. He quarrelled with Governor de Mézy and was ordered out of New France in September, 1664. Accordingly he sailed for Europe but Louis XIV took Bourdon's part in the dispute. In the following year Sieur de Courcelles replaced de Mézy. It was at this critical juncture in colony affairs that Jean Talon was appointed Intendant for his first term of service in Canada. Here was a man of position and influence who was more than ordinarily interested in the progress of mapping and surveying in the developing colony.

On December 6, 1666, the Governor also announced that His Majesty, King Louis XIV had approved the permanent appointment of Jean Bourdon as Procureur du Roi au Conseil. This was a high post with responsibilities of a law officer, a sort of Attorney General to the Supreme Council. This action served to mark the beginning of a new dispensation in the colony. The French court at Versailles was beginning to realize the true importance of Canada and thus raised its administration to the status and dignity of a royal government. From this time on its Governors were appointed by commission direct from the King. It was from this time onward, at least until the middle of the 18th century, that the colony became generally known in Europe as Canada or as La Nouvelle-France. Its total white population at the time was about 7,000.

Bourdon did not long enjoy the fruits of this high public office. Well within two years from the initial announcement he had been gathered to his fathers. His death occurred in Quebec on January 12, 1668. As had Samuel de Champlain before him, Jean Bourdon had played a vital part in establishing the tradition in Canada of land surveyors serving unselfishly in public life and community affairs. As a mapper Bourdon, like Champlain, made a highly significant contribution to the advancement of New World cartography. In that scientific field he laid the foundations of the work that was so ably carried on in later years by Franquelin, Jolliet, Deshayes, Father Bonnécamps and others.

Four years after the death of Jean Bourdon the Quebec colony received a youthful immigrant of great promise in the person of French-born Jean Baptiste Louis Franquelin. The son of Guillaume Franquelin and Catherine Vitas he was born about 1651 at St. Michel de Villebernin in the Archbishopric of Bourges, France. There appears to be no authentic record of the exact day or year of his birth but in the 1681 census of Quebec, Franquelin gave his age as thirty years.[12] Refined and learned, yet unpretentious in manner, Franquelin had been admirably trained in the art of cartography in the Department of the Marine in Paris. It is not clear from existing records just what, in 1672, induced this talented map maker to come to Canada, and it was not until 1678 that his name appears for the first time as author at the foot of a map. It was a production designed to explain the register of surveys in the colony. From that time on Franquelin


1660
hospital
Le Sr Couillart
fort St Louis a
magasin h
Cap au diamant i
moulin l
Rue n
place darmes o
terre labourable p
Coteau Ste genevieve q
grand fleuve St Laurens

MAP 17. Plan of Quebec attributed to Jean Bourdon, 1660. The original is in the Bibliothèque Nationale, Paris. Reproduced from a copy in the Public Archives of Canada.

was kept fully occupied with hydrography and mapping.[13]

In the last half of the 17th century there occurred a signal upsurge in surveying and mapping activity in New France. In order to better comprehend the nature and scope of this development it is necessary to consider the flow of events within France itself at this time. The outstanding French administrator during the reign of Louis XIV was Jean Baptiste Colbert (1619-83). The King, coming to the throne at five years of age, was compelled to wait until he reached twenty-one before he could acquire actual governing power. In the meanwhile Colbert, a man of affairs with a flair for administering public finances, had become one of the monarch's most trusted advisers. Not all Colbert's subsequent administrative acts were unblemished by iniquities or cruelties but the catalogue of his constructive achievements is impressive.

Colbert engineered sweeping financial reforms in the business of government. Roads and canals were improved. He established the French Marine in 1669, but three years previously he had founded the Académie Royale des Sciences and provided it with an observatory. He gathered together in Paris at the Académie the best scientific minds of 17th century Europe. He brought from Italy in 1669 that eminent scholar, surveyor and astronomer, J. D. Cassini (1625-1717), to supervise in fact if not in name the programs of the new institution.

It was Colbert, in his ambition to introduce principles of orderly administration in the New World, who sent his favorite Jean Talon, not yet 40, to Quebec in 1665 as the first Intendant in Canada. Urbane, clever, dapper in appearance the self-confident Talon was one of the brightest gems in Colbert's crown of young administrators. But he was so young that he did not have sufficient practical experience.[14]

Colbert desired that the haphazard ways of the French settlers in the New World give way to a more sensibly organized form of community life. Settlement, he felt, should be contiguous and in the form of parishes, villages and towns, although he conceded that farming ought to form the chief occupation of the inhabitants (habitants). The basic concept of the Colbert-Talon plan involved twin goals of increased population and more concentrated settlement. These men felt that from almost every point of view the traditional link-in-chain pattern of settlement along the St. Lawrence was undesirable. By bringing together the settlers in more compact villages not only would defensive measures be easier to carry out but it would be much easier to govern and police the communities and serve them with clergy. Talon, in his day, actually established three model villages at Bourg-Royal, Bourg-la-Reine and Bourg-Talon respectively. Jesuits planned their village of Charlesbourg along the same lines with farmlands spread out from the community centre like leaves of a fan with ends cut off at right angles. Today Bourg-Talon has vanished from sight and the other two experiments in settlement were finally merged in Charlesbourg. After Talon's recall the whole idea was abandoned. His was the last attempt to create compact villages and by 1750 the pattern of land occupation had been firmly set in New France, so far as its French inhabitants were concerned.

The longer Jean Talon remained in the St. Lawrence country with its immense vistas of land, forest and water, the more deeply he came under the spell of the majestic surroundings. This kind of osmosis, in turn, worked a strange change in the chemistry of his nature. In harmony with his environment Talon developed uncharacteristic visions of a vast French empire in the New World. In the passage of time these expansive and expensive fantasies at first disturbed and then confounded his friend and patron Colbert in distant Paris. But at the outset Talon's enthusiasms evoked tolerance, if not encouragement. Bourdon's cartographical work and ability, for instance, were well known to both Colbert and Talon.[15] In fact Colbert, in March, 1665, during a visit of Jean Bourdon to France, gave detailed orders to Talon in regard to the construction of a chain of forts along the Richelieu River. The instructions must have been based on a Bourdon map or memorandum. In addition, by the time of his first arrival at Quebec, Talon had been impressed already by the practical value of accurate surveying and mapping in the context of French America. As time elapsed the uses to which these arts could be put fitted more and more naturally into the pattern of Talon's grand design.

One of the first aspects of New France to catch Talon's attention was the Jesuit College at Quebec patterned after its Old World counterparts. Teaching had commenced in the institution in 1635, the year of Champlain's death. Nearly all the Jesuit Fathers on the College staff had either studied or taught at the Collège Henry the Fourth de La Flèche in France. Graduates of the astronomy, hydrography and mathematics courses included such distinguished persons as Descartes and Merseune.

Talon soon adopted a fault-finding policy towards the colonial institution. In this pose he may have been reflecting the attitude of Colbert who wished to see the power of the Jesuits in the New World curbed somewhat. It was Colbert who, in 1670, authorized the re-entry to New France of the Récollets. Ten months after his arrival at Quebec Talon was invited to attend a debate in the Jesuit College. He could not refrain from entering the discussion with spirit and displayed special knowledge and forensic ability. He revealed to the Jesuit Fathers his profound disappointment over the lack of any full-term teaching of mathematics at the College. He felt that such a course was not just a luxury but could be very practical, especially in the realm of navigation and hydrography. He thought the latter subject should be taught throughout the entire year. He was convinced that with the growth of the colony there would develop a steadily increasing need for ship captains well-versed in hydrography. In this respect Talon was certainly far-sighted.

The Jesuit professors rose to the occasion. Since about 1651 a lay professor of mathematics, one Martin Boutet, had resided at the College. He was willing to teach hydrography on an extra-curricular basis. Thus in 1666 Boutet began to lecture in the new course. As a teacher of marked ability his reputation grew. In 1671 Talon wrote, "The young men are taking eagerly to the school for the teaching of science, arts and trades and especially navigation so that with a little encouragement in that direction there is reason to hope that this country will become a nursery for navigators, fishermen, sailors and mechanics. Le Sieur Saint-Martin (who is with the Jesuit Fathers in his capacity of "frère donné" and who is well-versed in mathematics) had consented, at my request, to act as teacher".[16] Evidently Talon hoped for nothing less, in time, than a marine institute at Quebec. Boutet lectured tirelessly, training pilots, granting certificates in surveying and, in any spare time available to him, doing some surveying himself.

Boutet had time, in his earlier years in Quebec, for non-mathematical pursuits. He had some knowledge of church music and was well acquainted with the ceremonies of the church. Thus he served as master of the choir and taught chants and rituals. By his contract with the Jesuits he was also to board two children in his house for 300 livres each. In 1659 the number of boarders in his home was increased to four.

By October, 1676, Father Jean Enjabran, writing from Sillery near Quebec, stated in reference to Martin Boutet, "he has instructed captains of most of the ships which come to this country".[17] It is altogether likely that Boutet taught mathematics and hydrography to Louis Jolliet. Boutet's residence on Trésor Street still stands, close to what is now the central square in the City of Quebec.

In January, 1674, a development of considerable interest to the surveyors of New

France took place. A complaint was lodged with the "Conseil de la Colonie" that the compasses and instruments used by surveyors for laying out property boundaries and lines had not been uniformly accurate. As a result some rather bitter disputes were occurring among land owners. The Council ordered surveyors to bring their compasses and instruments to Martin Boutet, the professor of mathematics, for any necessary adjustments. He was to standardize their measuring functions. It was provided that surveyors should set four boundaries on the large square of Lower Town, Quebec, two on the north-east and south-west rhumbs and two on the south-east and north-west rhumbs and correct the variations caused by compass deviations. It was also provided as a condition to be met before entering practice that any new surveyor offer his instruments to Martin Boutet for the purpose of equalizing the same.

In France, inspired by the enthusiasm and leadership of Colbert, scientists were turning their attention to some of the more pressing problems in surveying and mapping. By 1669 the newly-founded Académie Royale des Sciences (now the Institut de France), had become increasingly active in this developing field. The experts in geography had become convinced that in order to bring about any worthwhile improvement in maps and mapping it was necessary to ascertain more precisely the number of miles or leagues in a degree of latitude or of longitude. Some scientists concentrated upon the construction of new or better instruments of measurement, others relied upon telescopes, compasses and other surveying tools in an effort to obtain a more accurate measurement of the earth's circumference, and correspondingly, the true value of a degree of arc around the circle of the earth. The Royal French surveyors adopted the same approach to the problem as that employed by Eratosthenes. But instead of estimating the distance between two selected points on the earth's surface, every foot of the ground along the base line was measured by the most accurate instruments then available. Jean Picard was the expert in charge of the project and he relied on the triangulation method. As his base line he selected the distance between a point near Paris and ran his line northward to Amiens, a distance of 32 French leagues. This survey occupied two years and when all calculations were completed, the results were found to be remarkably accurate.

In England interest was also growing in matters scientific. The nation's leaders wished to keep England in the running for the solution to the longitude puzzle. In 1675 Charles the Second ordered the construction of a Royal Observatory at Greenwich, overlooking the Thames, as a means of aiding in the advancement of nautical astronomy and navigation in particular.

From shortly before Jean Talon's arrival in New France until shortly after his departure there was a mild flurry of appointments to the post of surveyor in the colony. In 1663 Bénigne Basset received his commission and ten years later assumed the title of "first surveyor in the seigniory of Montreal". On July 27, 1696, he added an impressive flourish to his title, namely, "master legal surveyor in New France, resident at Ville-Marie". Basset died in August of 1699. On May 1, 1672, at a time when the total population of New France was under 7,000, Talon named Louis-Marie Boucher dit Buibuisson as a measurer and surveyor. M. Boutet signed the commission. In November of that same year Jean Le Rouge was commissioned and in 1673 the name of surveyor Jean Guyon began to appear on records of the colony. Martin Boutet died in 1683.

At the time of Martin Boutet's death the ineffective Joseph Antoine Lefebre de La Barre was Governor of New France. Mercifully he was in that high post for only one year. He showed no interest whatever in surveying and mapping facilities and services. His successor, Marquis de Denonville, was cast in a different mould. He had been only three months in Canada when he discerned the lack of any course in hydrography in the curriculum of the Quebec Jesuit College. He did not lose any time in seeking to remedy the situation. On November 13, 1685, de Denonville wrote to the then Minister of Marine in France, Marquis de Seignelay, drawing attention to the pressing need for such a course and suggesting that the King should appoint a teacher of navigation at Quebec. In this connection he recommended J. B. L. Franquelin or, alternatively, Louis Jolliet.

"It would be useful," wrote the Governor, "for the service of the King if someone here were appointed to teach principles of navigation. I think we have some worth-while students here, and also a man very capable of teaching this subject. His name is Franquelin and he is at present engaged in drawing maps. He knows many good things (worth teaching); he would be very useful if you were kind enough to give him some subsistence; he could teach writing, drawing, navigation and arithmetic. Canadians have all the qualities for becoming good pilots provided they be given the means of learning".[18]

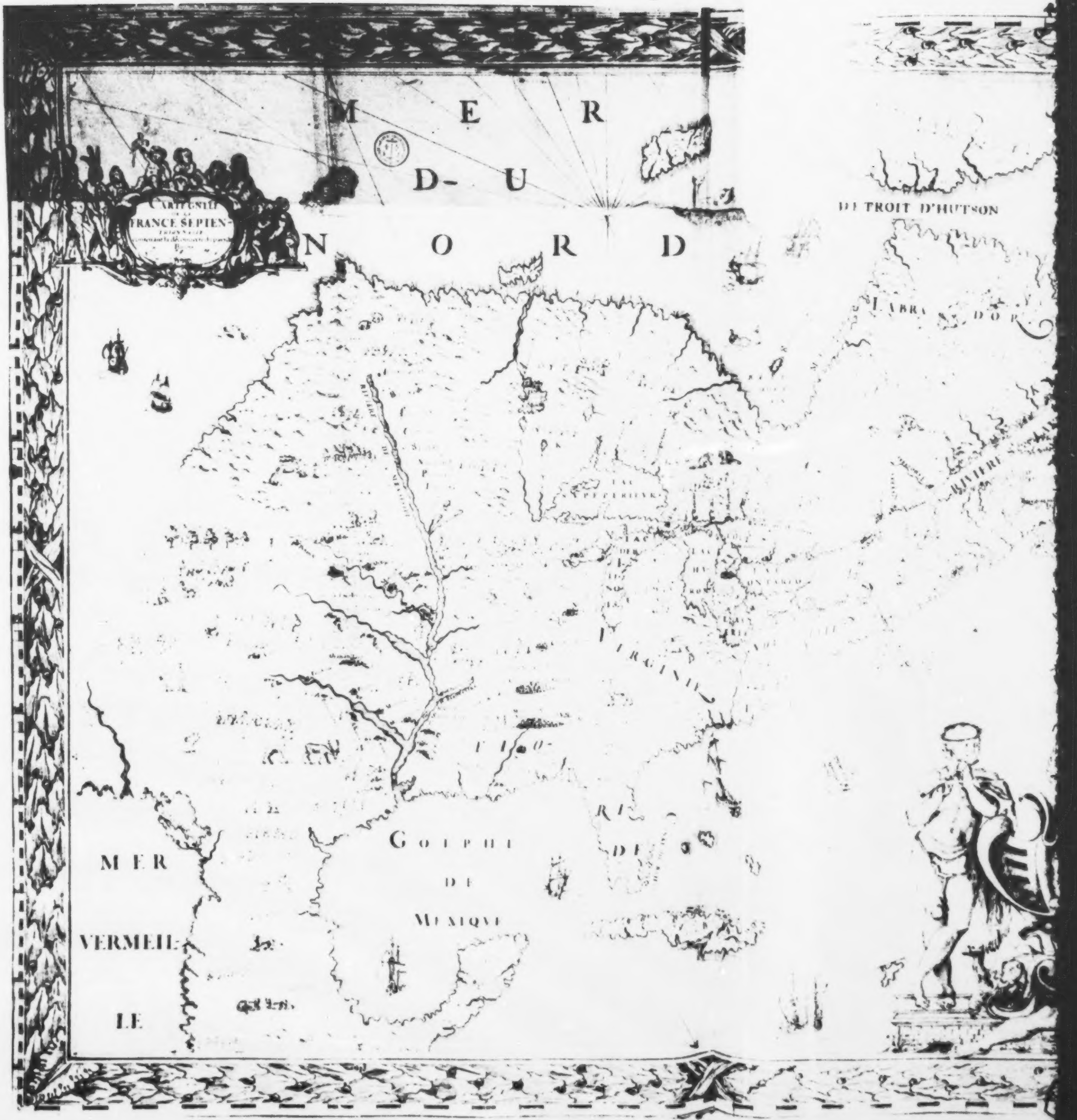
On the subject of Jolliet the Governor writes on the same occasion to the Minister, "I have had Sieur Franquelin make drawings of sketches of Sieur Jolliet. The latter is seriously interested in his work and has made a thorough study of our river. He has had a great share in many of the discoveries made in this country. He is a good man and could also teach navigation and form pilots in this country if you were kind enough, my Lord, to give him some subsidy each year."

On May 8, 1686, de Denonville followed up with a second plea, "The Jesuit Fathers have had one . . . who informed all those whom we have, who understand navigation and who serve our merchant ships. It is some time since this man died. Unless the King does something, we shall have no one. Meanwhile we need pilots, five having died in the past three years . . ."[19]

But unknown to de Denonville, Seignelay had already acted. In 1685 he had appointed Franquelin hydrographer at Quebec with a salary of 400 livres per annum. But Franquelin had not been the only candidate for the post. Louis Jolliet had applied also to be named teacher of hydrography at Quebec. Evidently the Minister of Marine, without much hesitation, preferred the French-born Franquelin to the Canadian-born Jolliet. It is likely that Franquelin had more influential friends than Jolliet had in the French court. In any event Franquelin was more of a cartographer than he was a teacher. It would seem that fitness to teach was not, for this time and in this place, the supremely important qualification.

In 1674 or 1675, several years after Franquelin's arrival in Canada, Count Frontenac and Intendant Duchesneau persuaded him to devote his time to map making as "the only one in the colony equipped for this work and in view of the growing demand from France for maps of the colony". Franquelin was, in all probability, the most expert map maker in New France, if not precisely the only one in the country. But he did not receive any government salary for twelve years, until 1686, after he had commenced drafting work! He must surely have been in business as well either as a merchant or trader, or both, in order to have survived during this period.

As time went on it became increasingly evident that Franquelin was not entirely happy in his professorial role. His discontent was communicated, by friends or by himself, to his superiors in the colony. Under date of November 6, 1687, de Denonville wrote jointly with Intendant de Champigny to the Marine Minister, Marquis de Seignelay, asking that Franquelin be employed exclusively as a map maker and that his teaching duties in regard to navigation be left with the Jesuit Fathers. These requests, however, seem to have been ignored, as were later representations of a similar nature.


FRANCE SEPTEN-
MER
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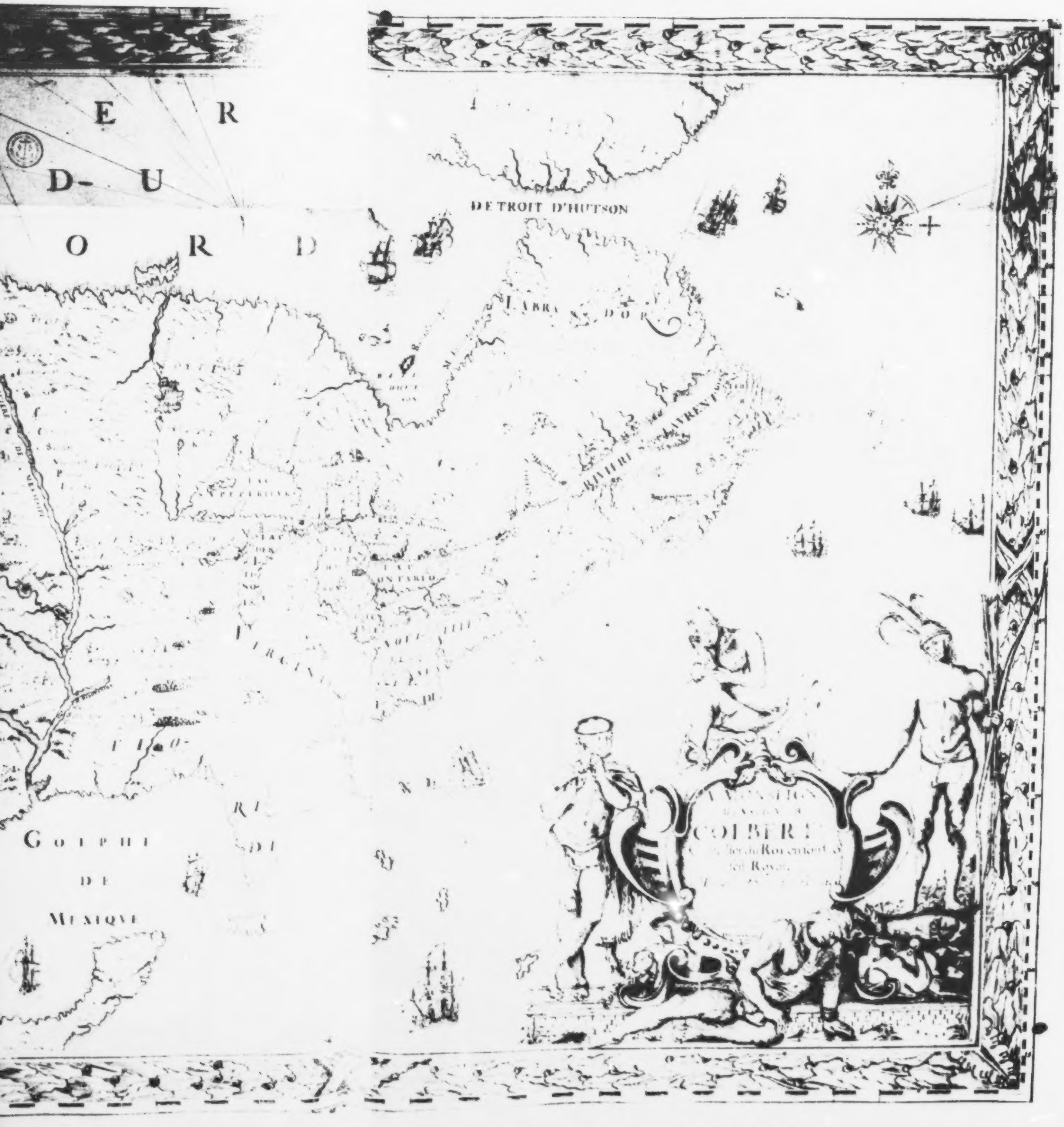
LAC SUPERIEUR
ONTARIO
VIRGINIE
RIVIERE
GOLPHE
DE
MEXIQUE
MER
VERMEIL-
LE

MAP 18. "Carte Gnlle de la France Septentrionale Contenant la découverte du pays de llinois Faite par le sieur Jolliet" by J. B. L
The original is in the Bibliothèque Nationale, Paris. Reproduced from a copy in the Public Archives of Canada.


E R
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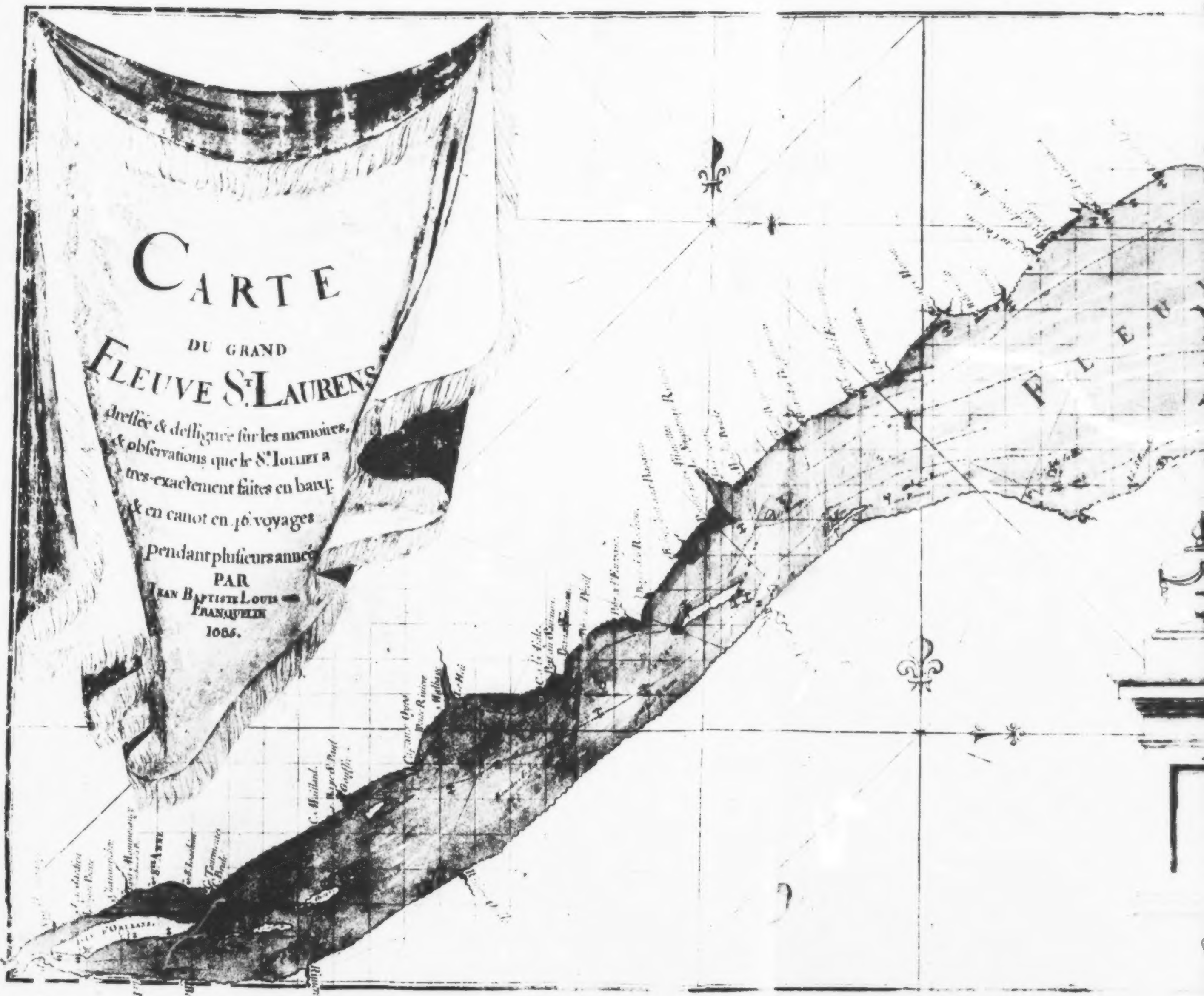
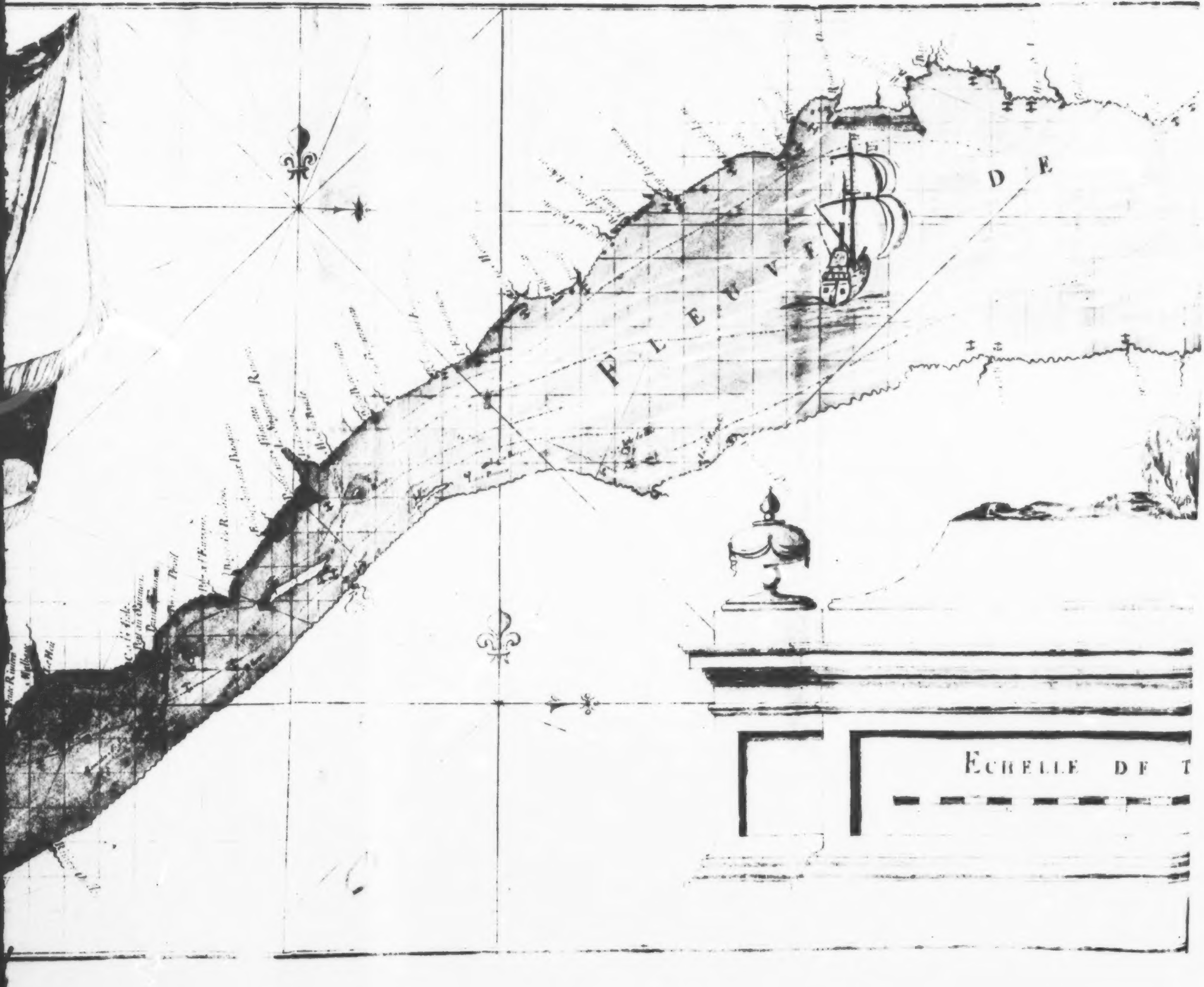
LABRA DOR
RIVIERE S. LAURENT
ONTARIO
VIRGINIE
GOLPHE DE MEXIQUE
COLBERT

rte Gnlle de la France Septentrionale Contenant la découverte du pays de Ilinois Faite par le sieur Jolliet" by J. B. L. Franquelin, 1678.
in the Bibliothèque Nationale, Paris. Reproduced from a copy in the Public Archives of Canada.


CARTE
DU GRAND
FLEUVE St. LAURENS
dreſſée & deſſignée ſur les memoires,
& obſervations que le Sr. Iolliet a
tres-exactement faites en barq
& en canot en 46 voyages
pendant pluſieurs années
PAR
Jean Baptiste Louis
Franquelin
1685.
FLEU

MAP 19. Reproduced from a copy in the Public Archives of Canada. The original is in the Bibliothèque Nationale, Paris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AP 19. Reproduced from a copy in the Public Archives of Canada. The original is in the Bibliothèque Nationale, Paris.

In a letter by Father Chabaud, a missionary in Quebec, dated November 29, 1688, there is an indication that Franquelin was in France for at least part of that year. "Our mathematician Franquelin," the good father wrote, "is going to the Court; he takes away a very large map which you can see at M. de Segnelé's". This was a map on which Franquelin had worked for sixteen years.

When the venerable Count Frontenac came to New France for the second time as its Governor (1689) Franquelin renewed his efforts to break away from teaching duties and made known to the Governor his aching desires in that regard. The situation was handled by Frontenac with shrewdness and delicacy. The newly returned Governor persuaded home authorities to recall Franquelin to France in order to make a report on his special field of instruction. Once in Paris Franquelin pressed hard to be relieved of his burdens. Thus it came about that he was appointed a cartographer in Paris. He urged the appointment of Louis Jolliet as his successor. But it was not until 1695 that Franquelin's resignation from his teaching post at Quebec was officially accepted.

It is interesting to note that in a memoir to the French court in March, 1689, Franquelin made certain recommendations on surveying in New France. He emphasized the importance of drawing correct lines along the outer limits of the King's domains, of establishing boundary posts and of making exact maps of the lands surveyed. "It appears necessary," he wrote, "to divide this huge country into provinces which would be delimited and designated by permanent French names, as well as special rivers and spots; for this we would suppress all Indian names which bring confusion only because they are changed very often and because each tribe gives its own designations, so that one place has always many names". His complaint foreshadowed the submission of many similar grievances by Canadian cartographers of the future!

When Franquelin's resignation as teacher of hydrography at Quebec was finally accepted in 1695 the sagacious Count Frontenac found a reason to send Louis Jolliet to France. From this and other subsequent happenings it would appear that in order to obtain such an appointment as Jolliet was seeking, it was essential not only to be a skilled cartographer but to possess friends in France whose recommendations were well regarded by the Minister of Marine in Paris. At any rate Governor Frontenac and Intendant de Champigny wrote to the Minister that they had promised to employ Jolliet as cartographer and that Jolliet had begged to be appointed to the post of hydrographer at Quebec which "had been held by Sieur Franquelin". After Jolliet returned to Canada with the appointment, the Minister, Sieur Lagny, received a letter from Frontenac in October, 1696, thanking him for the action he had taken.

Jolliet died suddenly in 1700 and once again the mails to France carried urgent official representations regarding the vacant professorship. Louis Hector de Callières had succeeded Frontenac as Governor. With Intendant de Champigny a joint letter was written to the Minister in Paris praying that His Majesty the King would see fit to grant to the Jesuit Fathers at Quebec 400 livres per annum, the amount Jolliet had received, because the Fathers had offered to teach the subject of hydrography. But the response to these representations brought only dismay to the college at Quebec. Word was received that Franquelin had again been appointed professor of hydrography!

But Franquelin never did re-occupy the professorship. Just what changed his mind over the appointment or prevented his return to Quebec, remains an unsolved mystery. His absence from Canada led to another joint letter to Pontchartrain from the Governor and Intendant, dated October 5, 1701: " . . . as Franquelin . . . is not coming this year to this country . . . seeing that the Jesuits have been teaching (hydrography) since the death of Sieur Jolliet and have even begun to teach it at Montreal in the hope that they may be given this post, we believe, my Lord, that it would be only just that they be paid for the year during which they have taught the subject".

The real reason for Franquelin's failure to make the trip to Canada can only be surmised. It may have been the result of his wife's uncooperative attitude, a fear of renewed privations, the hostility of creditors or a combination of all these factors. Also it is quite possible that Vauban might not have wanted him to leave France and his employ. In any event Franquelin lingered on in Paris after his formal appointment. Finally he prevailed upon His Majesty to appoint Jean Deshayes to the teaching post and to be royal hydrographer at Quebec.

It may be stated that, viewing the world from the European stage, the reign of Louis the XIII was the age of eminent French family firms monopolizing by merit the map publishing industry in that country. The Sanson family, headed by Nicolas (1600-67), began to build a reputation for map making and map printing that stood very high in the world of cartography for a period of about 150 years. This family group, consisting of the father and sons Nicolas, Guillaume and Adrien, commenced about 1650 the publication in Paris of an impressive series of printed maps of North America. The first attempt, in fact, to depict the Great Lakes with fair accuracy is embodied in Sanson's map *Amérique Septentrionale* of 1650. In this production there is clear evidence of the strong influence of Jesuit explorations and geographical reports upon cartography related to the New World. The outlines of Lakes Ontario, Erie and Huron are very well drawn. In their relative proportions and locations this early map of the lakes resembles the work of modern surveyors. Lakes Michigan and Superior, however, were less correctly delineated. In his Relation account of 1647-48 Father Ragueneau made an elaborate geographical survey of Canada, as it was then comprehended, providing much useful information.

The Sansons remained foremost in the map-producing field in France until the early 1700s when the Delisle family came into prominence. Guillaume Delisle, the father, who trained his four sons in the craft, is regarded by some authorities as the founder of modern geographical science. Both Nicolas Sanson and Guillaume Delisle were, in their time, named royal geographers. The greatest care was exercised by C. Delisle in the use of numerous Jesuit sketches as a guide in his map making.*

During this general period Father Coronelli was regarded as the dean of Italian geographers. He was named geographer to the Republic of Venice in 1685 and while in that position compiled a number of maps, among them an excellent portrayal of the Great Lakes and Mississippi Valley, published in 1688.

In the Netherlands the Blaeu family became very active in the map publishing business in the 17th century. Willem J. Blaeu (1571-1638) set up his own map engraving shop in Amsterdam in 1600, introducing his two sons, John and Cornelius, to the profession. Willem had studied astronomy and geography under the learned astronomer, Tycho Brahe. By 1603 Willem had constructed a pair of globes, his initial ventures in the cartographic realm. The Blaeu firm flourished and by 1637 had moved into larger premises, employing the best pressmen, engravers, color artists and clerks in Holland. Probably the best known product of the Blaeu press was their *Atlas Major* in 12 volumes, a geographical work that was, in many respects, the most artistic ever published. This accomplishment marked the completion of 30 years of distinguished publishing in the world of mapping.

In so far as Franquelin's cartography is concerned, it may be said that the ten years

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*In the Map Division, Public Archives of Canada, Ottawa, file JJ 75, consists of Jesuit sketches used in compiling the Delisle master map of 1700.

1681 to 1691 were the most productive of his career in New France. During the governorship of de Denonville (1685-1689) he produced the largest volume of completed maps of his entire stay in the New World.

In 1681 Franquelin combined three well-known maps to complete his "Carte Contenant une Part du Canada". He employed Sanson's map of 1650, the Jesuit's map of the Great Lakes 1670-71 and Jolliet's map of 1674 made following the latter's exploration of the Mississippi with Marquette. This 1681 map represented the peak of mapping developments of the initial French period of intensive cartography in the New World. This map also foreshadowed mapping at a steadily increasing pace of the interior of Canada because it included such new geographical features as the Lake of the Assiniboels, Severn River, Lake Nipigon and Nipigon River as well as the Albany River. It marked the beginning of a second period in what might be termed the mapping of the Canadian Near West.

This was almost wholly a period of French mapping. England, limited for the most part to Hudson Bay and adjacent regions, contributed relatively little to the cartography of this era. There can be no doubt that Franquelin in his time drew by far the greatest number of maps, both general and sectional, of any cartographer of that part of North America now known as Canada. Even so, as far as is known, he did not travel west of Montreal. Jolliet, on the other hand, frequently made maps based on actual surveys or personal observations in distant parts and, on occasion, strictly from memory of what he had perceived.

In 1683, the year of his marriage to Elizabeth Aubert at Quebec, Franquelin produced a splendid plan of Fort St. Louis, also a plan of Upper and Lower Town (Quebec). These are the only examples of his cartography of that year known to have survived to this century.

In 1684 Franquelin drew a general map of America and of Louisiana. This map is not of great significance to Canada. Acadia, for example, is depicted in an erroneous fashion. In 1685 Franquelin produced a map of the St. Lawrence River based on the notes and observations of Louis Jolliet and in 1686 he designed and revised a map of 17th century North America. This could qualify as a "mother map" of many to follow. For instance for the first time the Severn River was depicted in a relatively accurate location. Franquelin's artistic and professional competence had increased noticeably in his years in Canada. Francis Parkman, the historian, had remarked of one of his earlier maps, "This map, early effort of the engineer Franquelin, does more credit to his skill as a designer than to his geographical knowledge which appears in some respects, behind his time".[20] It is a criticism that could not, with justice, be applied to Franquelin's work in the 1680s.

Before his departure for France in 1688 for a visit there, Franquelin had been commissioned by the Governor and Intendant "to go next year to the Ottawa country and draw a map of that region". We know that in 1689 he drew a map of North America in which Quebec, as viewed from the east, is included.

Although Franquelin did not travel much in New France, he managed to make a number of voyages to Europe while he was domiciled in Quebec. Not the least astonishing aspect of these transatlantic crossings was his ability to finance them. In 1683, for example, he travelled to the French court, bringing the maps and plans that had been requested of him. He journeyed at his own personal expense, a project that involved an outlay of 1,500 livres and for which he received no reimbursement. For one who was almost constantly in debt to others, this is a considerable triumph. In 1688 he made another voyage to France which cost him 1,600 livres and in this case he was granted

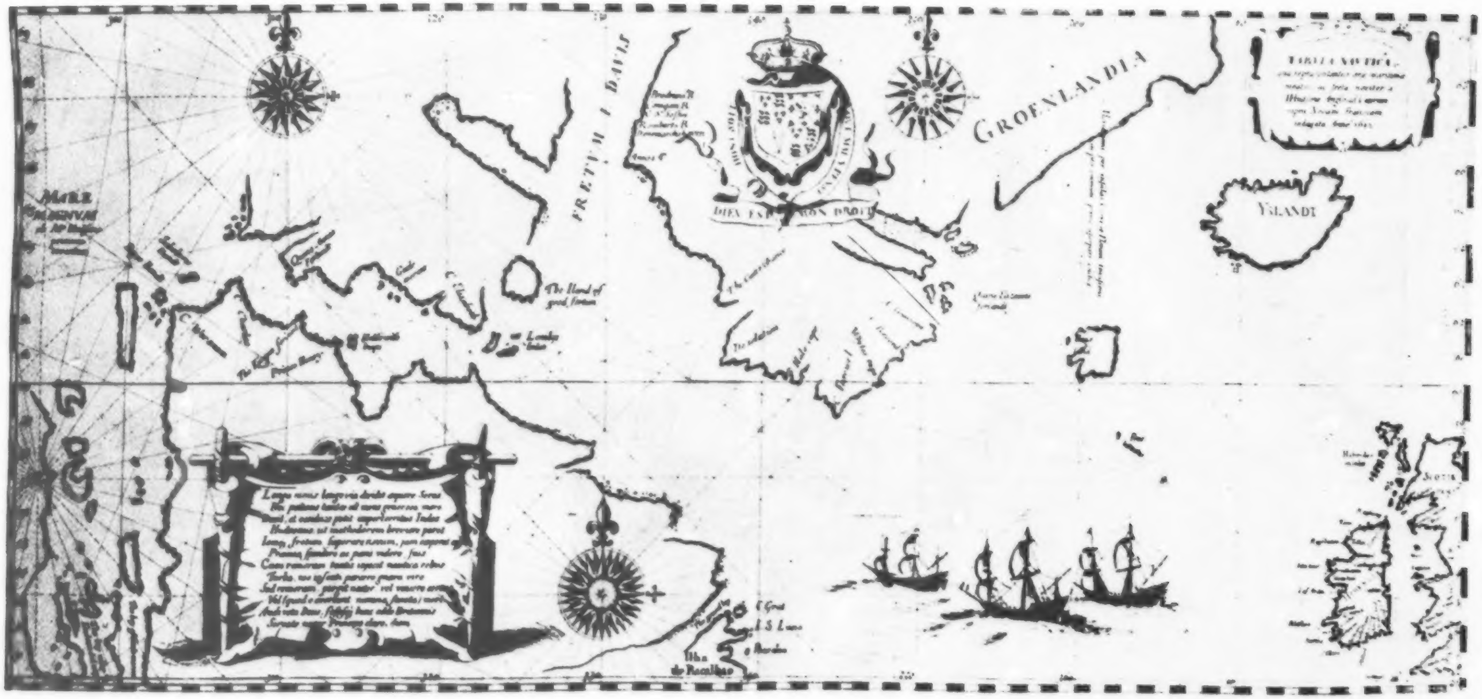
400 livres towards travel expenses despite the fact that he had made the trip on orders from the Governor.

But there were some revealing glimpses of financial stress. During his 1688 stay in Paris there was an incident not only eloquent of fiscal strains but also an indication of the presence in Canada at that time of two engineers, Robert de Villeneuve and Jean Deshayes. Franquelin, it appears, approached the Minister of Marine for a formal commission "and the same salary as that of engineers in Canada in addition to his present salary" as he "will have to pay a draftsman in Quebec to draw the maps so that these can be sent to France each year". It is considered by historians of this period in Canada that these references could only apply to de Villeneuve and Deshayes. In his memorandum Franquelin also urges that the work of determining the boundary line between French and English territory ought to be undertaken first in the Iroquois country but it is just as important "to settle limits between French and English possessions in the Hudson Bay region". In this regard Franquelin showed commendable foresight but events soon combined to prevent any action on his sound advice. The terrible massacre of French settlers at Lachine as a result of an Iroquois attack led to the departure of de Denonville in November, 1689. He was replaced by Count Frontenac, recalled from retirement in France at this time of awful emergency for the colony. Frontenac arrived at Quebec in the evening of October 12, 1689 while the colonists were still in a state of severe shock from the outrage. The matter of determining jurisdictional boundaries would have to await calmer times.

We know that in 1692 Franquelin produced a map of New France and in the following year one of New England. But it was in 1692 that Frontenac decided to send Franquelin to France with maps. For lack of funds Franquelin was "unable to return to Canada". In the following year Madame Franquelin with several of their children sailed to join him in Paris. Franquelin did not return to New France in 1694 as expected in Quebec and, in fact, never set foot in Canada again.

All the information available indicates that Franquelin was a mapper rather than a teacher. He was also more a cartographer than an engineer. Not that he was incompetent in the latter occupation. Frontenac attests that Franquelin did perform duties as an engineer during the first siege of Quebec by the Kirkes and that Franquelin in his work on that occasion "acquitted himself perfectly". This siege, in fact, prevented Franquelin from sending any maps to France in 1690. But de Denonville in January 1690, after his return to France, wrote that "The school of hydrography would be better in the hands of the Jesuits than in those of Sieur Franquelin who does not bother much about forming the pilots the colony greatly needs".[21]

Although Franquelin was a map maker of exceptional skill and capable of production of maps in large quantities, he failed to achieve the wide and lasting fame he and his works deserved. This is just another example of an exceptionally able but modest man being lost in the competitive scramble of more aggressive, if not more gifted rivals. As a mere draftsman in the employ of the Governor of New France his manuscript maps were sent to the home government in Paris where others made use of his work and incorporated his accomplishments, without any credit lines, in their productions. Peculiarly, none of Franquelin's maps were published under his name. His achievements were always overshadowed by the reputation gained by others in Europe in the same field of endeavor. Finally, six years after his arrival in Quebec, his name appeared for the first time as the artist on a map . . . "dans les cartons des archives de Paris dix-sept cartes inedites (par Franquelin)". In the first period of French mapping of the New World, the name of Sanson was supreme. In the second period, 1681


GROENLANDIA
YSLANDT
FRETUM I DAVIS
DIEU ET MON DROIT
The Iland of good fortune
Ilha de Bacalhao
MARE

MAP. 20. The first map to delineate Hudson Bay. Printed in H. Hudson and others, *Descriptio ac delineatio Geographica Detectionis Freti . . .* (edited by Hessel Gerritz), Amsterdam, Hessel Gerard, 1612.

to 1731, Franquelin, Delisle and Jaillot were the most eminent French cartographers of territories in North America. In the period to follow, N. Bellin's work was to prove exceptionally important. Du Val and De Fer were two other French geographers who were very active towards the end of the 17th century and the beginning of the 18th. At this time French knowledge of Hudson Bay rested almost entirely on a 1612 map by Hessel Gerritsz, chronicler of early English expeditions into the Bay. His map, published in the Netherlands, was copied by Champlain in his 1613 and 1616 maps. Most of the leading French cartographers of the 17th century were interdependent. Sometimes they worked with each other closely, and often borrowed from each other cheerfully. But the unassuming Franquelin, as far as we know, was the only one of this distinguished coterie of map makers ever to live in New France.

Because he depended upon the sketches and field notes of others and sought to reconcile them as best he could, certain weaknesses mar Franquelin's best work. On all of his maps the east-west length of the Great Lakes is much too great. On his 1684 map, for instance, the spread between Duluth and the outlet of Lake Ontario is 27 degrees of longitude, or 1,323 miles, whereas the actual distance is 767 miles! Nevertheless one of the most important contributions made by Franquelin to the cartography of his time consisted in expressing in an artistic manner on flat surfaces, the sketches and field notes of explorers, surveyors and missionaries.

It is one of the strange coincidences of history that in the case of both Jean Baptiste Louis Franquelin and his successor in the post of royal hydrographer at Quebec, Louis Jolliet, the precise times and places of death remain unknown. Franquelin is thought to have died in France sometime between 1712 and 1730. Jolliet is reported to have died on one of the St. Lawrence Gulf islands in 1700, but the exact date and place are a mystery to this day.

8

DIRECTION FINDERS OF NEW FRANCE

By the middle of the 17th century French settlement in the St. Lawrence River basin was being matched by growing settlements of English and Dutch along the Atlantic seaboard to the south. In New England, after prolonged disputes between England and France over the right to colonize certain areas, England finally gained supremacy. But the pattern of occupation was haphazard. Frequently settlers located and developed sites without first establishing their title to the land. Such was the course followed by the Pilgrim Fathers and others along the shores of Massachusetts Bay. Settlement usually developed in the form of closed communities or towns in which some land was held and used in common. As colonization grew, it became necessary in time to regulate and regularize land-acquisition procedures. As early as 1634 committees of settlers were appointed to fix boundaries in dispute. In 1641 each town was ordered to mark properly the boundaries of its grant within a year's time.

The size of community land grants in New England for town settlement varied. Earlier town areas extended over 8 to 10 square miles. With the advantage of actual experience in administration it was found that 6 square miles represented as much land as a community could absorb effectively and conveniently. Accordingly 6 square miles, or its equivalent acreage, became the customary size of a New England township.

In the New Netherland (or New York) area, as settlement gained momentum it followed no preconceived pattern or order. To eliminate some of the confusion that resulted and to reassure prospective immigrants, the Dutch secretary under Stuyvesant wrote to home authorities in Holland in 1650 assuring the people of that country that suitable village sites would be selected and made available to newcomers. Before buildings were erected, the village site would be surveyed, streets and lots laid out and the land outside the village limits divided into tracts for cultivation. Tracts of woodland and pasture not allotted to individuals were, by tradition, used in common.

These, then, were some of the surveying and settlement developments taking place to the south of New France during the period when Champlain's immediate successors in office, Montmagny, D'Ailleboust and Lauzon, were directing the affairs of the French colonists and when Jean Bourdon acted as chief authority over land surveys and hydrography.

At about the same time that the grateful Jesuit Fathers of the Quebec College were making the presentation of a telescope with compass to Jean Bourdon, Louis Jollyet was born at Beauport near Quebec.

Information on the youth of Louis Jolliet (or Jollyet) is scanty. It is known that his father died before Louis reached the age of six years. There are indications that Louis attended courses at the Jesuit College, Quebec, in the late 1650s. During these college days his musical talents were in demand as an organist. Record of his participation in a college debate on July 2, 1666, is additional evidence of his versatility. The year following proved to be an important one in the career of the young Canadian. So favorably did he impress Bishop Laval that the churchman arranged a voyage to France for him. The 22-year-old Jolliet, without means of his own to pay the costs of such a formidable trip, borrowed from Bishop Laval for the purpose.[1] In addition to this Laval suggested to Louis that he see the bishop's friend in Paris, M. de Charny, youngest son of the fourth Governor of New France, Jean de Lauzon.

Louis Jolliet commenced his exploration surveys in the New World at a relatively early age. At 25 he was travelling in Indian country as far west as Lake Superior in search of a copper mine. Reports of its existence had reached Talon, the Intendant who had been eagerly searching for mines along the St. Lawrence River since his arrival in New France in 1665. The prospecting errand proved fruitless and Jolliet, it is thought, spent the winter of 1670-71 at Sault Ste. Marie.

The year 1672 was marked by the arrival in Canada of Count Frontenac to serve the first of two terms as Governor of New France. It was a year of significant events. Among other developments Talon commissioned Jolliet to search for a water route to the so-called Sea of the South. The same frugal fiscal policy of which Jean Bourdon had been a victim and which Franquelin (who arrived at Quebec in this same year) was destined to experience, was applied to Jolliet. Although officially instructed to undertake this mission of exploration, the administration did not pay any of the expenses of the journey. Rather he was to recoup himself from surplus proceeds arising out of the use of a fur-trading permit.

Geographical concepts of the time concerning the interior of the North American continent, appear odd to 20th century eyes. Mention of a great river in the West is to be found in the Jesuit Relations 1666-67. In the journal of Father Allouez we find reference to ". . . a great river, which as far as I can judge, empties into a sea toward Virginia. . ." And later in a letter the good Father remarks, ". . . it is hard to believe that the great river discharges its water in Virginia; we think rather that it has its mouth in California". Here the fervent wish may have been the father of the thought. The principal searching in those times was directed towards the shores of the Pacific, the access-way to the Orient.[2] In part the estimate of Father Allouez was colored by the fact that in maps of that period a high mountain range was shown, surrounding the southwest region of what is now the United States of America. Father Allouez would probably reason that the course of the great river might well be bent westward in a vast detour around the alleged mountain barrier.

Jolliet was accompanied on his southern survey by an interpreter, Father Jacques Marquette. Born in Laon, France, Father Marquette had, in 1669, replaced Father

Allouez at the mission on the southwest tip of Lake Superior, the same year that Picard began laboriously to measure his meridian line near Paris. In June of 1673, travelling down the Mississippi, the pair reached the latitude of 33 degrees, 40 minutes. On questioning Indians near the junction of what is now known as the Arkansas and Mississippi rivers, Jolliet learned that the latter continued to flow due south. Accordingly the expedition returned to Canada. As he approached Montreal Jolliet's canoe, which had raced safely through numerous dangerous cataracts, suddenly overturned in a series of turbulent rapids. Although he managed to survive, his priceless journal and papers of the trip were never recovered.

Nevertheless, in the following year, Jolliet drew from memory maps of his Mississippi journey, dedicating the principal map to Governor Frontenac in a letter inscribed thereon. Jolliet also wrote on October 10, 1674, probably to Laval, indicating the southernmost limit of his exploration. No portages had been required along the route and the river he described as "wide as the St. Lawrence at Sillery (1,650 feet . . . about half of its width at Quebec)". One of the main results of this mission was the conviction in French geographical circles that the "Father of Waters" discharged into the Gulf of Mexico rather than the Pacific, known as "Sea of the South".

Three years after his marriage in October, 1675, to Claire-Françoise Bissot, a revised version of the Jolliet map was dedicated to Colbert by Intendant Duchesneau. It bore the impressive title, "Carte Gnlle de la France Septentrionale Contenant la découverte du pays de Ilinois Faite par le sieur Jolliet".

Father Marquette also made a map on his return and the manuscript version of this product is now in the archives of Collège Sainte-Marie, Montreal. The latitudes, 30 to 48 degrees, are numbered on both margins of the map but the longitudes are not numbered. No existing map of this section of the Mississippi River made in Europe or Canada before 1700 proved to be as accurate as that of Father Marquette's. The original Jolliet map, sent to France, has since dropped out of sight. But some five maps based upon it are in existence, one drawn by Franquelin. The text of the Jolliet-Marquette journey down the Mississippi was published in Paris in 1681 under the title: "Voyages et Déscouvertes de quelques Pays et Nations de l'Amérique septentrionale".

In the year of Jolliet's marriage, La Salle, who achieved eminence as an explorer of the French regime, was busily occupied at Cataraqui, rebuilding its fort and constructing four vessels, the first constructed by white men to be launched on the Great Lakes. By 1679 La Salle had embarked on an expedition that took him to the mouth of the Mississippi nine years after Jolliet's journey on its broad waters. La Salle formally claimed for France the region drained by the river and named it 'Louisiana' after King Louis XIV. He met his death trying to found a permanent colony at the great river's mouth.

In spite of La Salle's impressive achievements, nothing could detract substantially from the heroism of Jolliet's exploratory ventures into the North American wilderness or from his scientific approach to the unknown. If it can be said that Jolliet had a valid claim to the title of hydrographic surveyor in his day, then he was indeed the first Canadian-born member of that valuable fraternity. In this connection a rather revealing letter, dated November 10, 1685, was written by Louis Jolliet to the Marquis de Seignelay in Paris, then Minister and Secretary of State.[3] Incidentally, we know that in 1684 Jolliet had drawn a map of Hudson Bay as the result of an expedition in 1679 he had conducted to the Bay, leaving Quebec on May 13th with eight men, returning on October 5th of the same year.

The letter to the Minister has been translated as follows:

"It is not without reason that from the very beginning ship captains coming to New France have always been apprehensive of the entrance of the Gulf of St. Lawrence and of the navigation from Anticosti to Quebec, a distance of more than 130 leagues (about 393 statute miles). It is known, my Lord, that several ships sent by His Majesty as well as by merchants, have been shipwrecked in the said river for lack of accurate and reliable navigation maps.

"Since I completed my studies in philosophy and mathematics 18 years ago I have acquired much experience during voyages made to the Mississippi River, Illinois country, . . . Lake Superior in the Ottawa country, . . . Hudson Bay, Anticosti and Newfoundland, always with dividers or compass in hand, noting every cape and spit, as well as the bearings from one to the other. This experience emboldens me, my Lord, to present to you this map which is (the result of) my work during the past six years. You will see marked on it all the coves, islands and islets, all of the coasts and sand bars from Quebec to Newfoundland. The pilots of the ships of His Majesty and of other ships have nothing to fear if they use this map and navigate by it.

"I do not hesitate to say that this map is complete, for I inserted in the final draft the information and the noteworthy details observed during 46 voyages on a barque and three in a canoe. Coves and anchorages, good and bad as well as the bearings are faithfully entered.

"I am not adding the map of the Illinois country, of the Mississippi, or that of the overland route to Hudson Bay, because the maps of these regions which have been sent to His Majesty these past years were all based on my memoirs, and those very enterprises which are now in progress in Canada are the result of information which I brought back. (Hence) it only remained, my Lord, to give you a map of the St. Lawrence River, as accurate and trustworthy as possible, for the navigation of barques and vessels, made by a man with several years experience . . ."

The hydrographic history of Canada might well be said to have started with this letter of Louis Jolliet to his Minister, Marquis de Seignelay, in 1685.*

In 1680 Intendant Duchesneau had written that the Anticosti Island seigniory (including the entire two-and-a-half-million-acre island) had been granted to Sieur Jolliet partly "in consideration of the discoveries made by him in the Illinois country of which he has given . . . a sketch which served as a basis for making the map sent two years ago to my Lord Colbert. . ."

After Jolliet's return from Hudson Bay and his subsequent letter to Seignelay, we have only fragmentary information on his activities, with the exception of his 1694 expedition to Labrador. It appears that he divided his time between Quebec and Anticosti during these late years of the 17th century. Assuredly he was in Quebec from November, 1693 to April, 1694. In 1694 he made a five-and-a-half-month voyage to Labrador. It is surmised that the expedition was the fruit of a realization that the exploration, survey and mapping of Labrador was sadly lagging. On April 28th Jolliet sailed from Quebec, returning in mid-October.[4] In his journal of the trip is this entry:

"On August 15th at noon, in clear weather, I measured the height of the sun above the horizon with the astrolabe and found 47 degrees, 45 minutes which means that we were at latitude 56 degrees, 11 minutes." (Zoar, the point where this reading took place is actually at 56 degrees, 8 minutes.)[5]

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*From very early times sailing charts were compiled from observations of navigators. Because of this close connection the French word "hydrographie" became largely synonymous (especially in the 17th century) with "navigation" rather than with hydrographic surveys. Nevertheless "sondage" (soundings) commonly formed an important aspect of "hydrographie".

It had been a long and frustrating battle that had been waged by Louis Jolliet and his Quebec friends in the effort to win for him the post of Royal Geographer and professor of hydrography on the Jesuit College staff. Finally success came in 1697, his commission being dated April 30th.[6] In the winter of 1698-99 he drew a map of Anticosti Island and the Gulf of St. Lawrence, a chart designed for the use of pilots entering the Gulf through Cabot Strait. It seemed that at the age of fifty-five Jolliet yet had in store many years of service for his king and country.

But fate sometimes displays a stolid, if not entirely heartless indifference to the loftiest ambitions and cherished hopes. Jolliet, despite willing and, in some instances, highly placed friends, despite undoubted talents as a cartographer and long practical experience in exploratory surveys, did not long enjoy the advantages of his important position. He passed away some time during the summer of 1700, little more than a year after the death of Count Frontenac and barely more than three years after his effective appointment to the post he had sought so long and fervently.

Louis Jolliet died in poverty that his large land holdings did little or nothing to allay. His widow died destitute. The location of the grave of the man who made widely known the existence of the Mississippi River and opened the way to an empire in North America, remains a mystery. In Canada the separation of hydrographic surveying from navigation is foreshadowed during Jolliet's career but the ultimate division of functions did not actually occur until 1720 with the formation of the Depôt des Cartes de la Marine et des Colonies, an institution from which the Service Hydrographique of France traces its growth.

Following a hiatus of four years Jean Deshayes succeeded Louis Jolliet as Royal Hydrographer and teacher of that subject at Quebec. Franquelin had taken on the job in name only but Deshayes took over the duties in name and in fact. We are without details of the date of birth or of the parentage of Jean Deshayes but it is reasonable to assume that he was at least fifty years of age at the turn of the 18th century, six years prior to his death. The family surname suffers from a variety of spellings in documentary reports referring to his career. Sometimes it is spelled DesHayes, Deshaies or, occasionally, Des Hayes. But in Canadian records, for the greater part, the name appears as Deshayes.

Jean Deshayes never did have a suitable opportunity to root himself very deeply in New France. He spent no more than four years in the colony, spread over two visits. The first stay extended from the spring of 1685 to the autumn of the following year. His second visit was from sometime in 1704 to his demise on December 18, 1706, in the Hôtel-Dieu at Quebec. Despite the brevity of his sojourn in Canada Deshayes, because of his exceptional reputation as a cartographer and astronomical surveyor, made a brilliant contribution to the development of those activities in the colony.

On both his visits to Canada Jean Deshayes met with cool receptions. In 1685 he was instructed to proceed to New France by Seignelay. The Governor of the colony, de Denonville, regarded his presence at that time as somewhat less than welcome. At that stage in the growth of the colony Franquelin was solidly in the Governor's good graces and had just received the appointment of Royal Hydrographer at Quebec. The Governor was therefore determined to preserve what he considered to be the best interests of Franquelin and, for that matter, the interests as well of the defeated candidate for the same position, Louis Jolliet, in preference over the new arrival from Europe. In addition Deshayes appeared to be in frail health, unprepared to meet the rigors of 17th century travel in the North American wilderness. When de Denonville took Deshayes with him on a canoe trip to Cataraqui during the mapper's first season in Canada to chart the river shoreline between Quebec and their destination, Deshayes became so violently ill he could not continue to work at his sketching. The Governor, in fact, thought that the newcomer would die before the outgoing journey was completed.[7] Nevertheless Deshayes produced a remarkably accurate outline of the St. Lawrence from Quebec to Lake Ontario, a work that became the basis for some of the best early maps of that part of Canada.

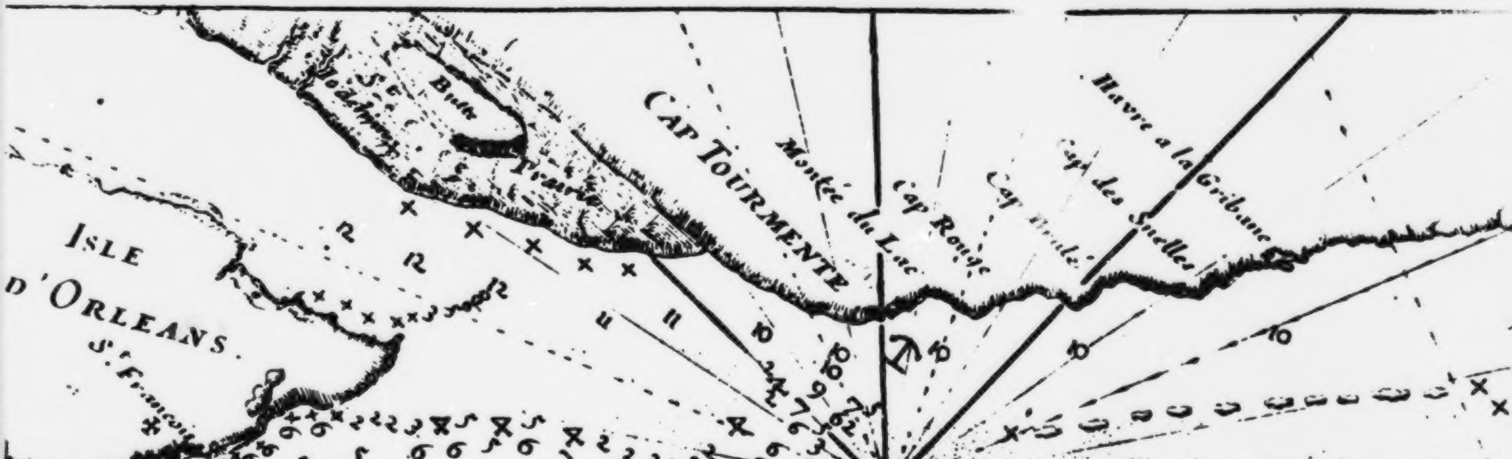
On June 17, 1685, Seignelay wrote to Intendant de Meulles concerning the assignment that Deshayes was sent to New France to carry out. His instructions related mainly to map making at the mouth of the St. Lawrence River and the minister included orders that a rowboat be obtained for Deshayes for that purpose. J.-Edmond Roy, in his study of surveying and mapping under the French régime, claims that Jean Deshayes came to New France primarily to make astronomical observations and that in 1686 he took advantage of a lunar eclipse to fix the longitude at Quebec at 72 degrees, 13 minutes from Paris.[8]

In the History of the Academy of Sciences, 1699, volume 38, 281, we read, "M. Deshayes, qui avait déjà fait des voyages de long cours, et un grand nombre d'observations, pour perfectionner la Géographie, ayant été envoyé par le Roi en Canada dans le même dessein, en a rapporté une Carte Marine de sa façon, qui comprend le cours de la Rivière de Saint Laurent, depuis son embouchure jusqu'au Lac Ontario. Il demanda au Roi un Privilège pour la Publication de cette carte et Sa Majesté fit l'honneur à l'Académie de la lui envoyer à examiner. L'Académie l'a jugée forte exacte et d'une grande utilité pour la Navigation de la Rivière St. Laurent".

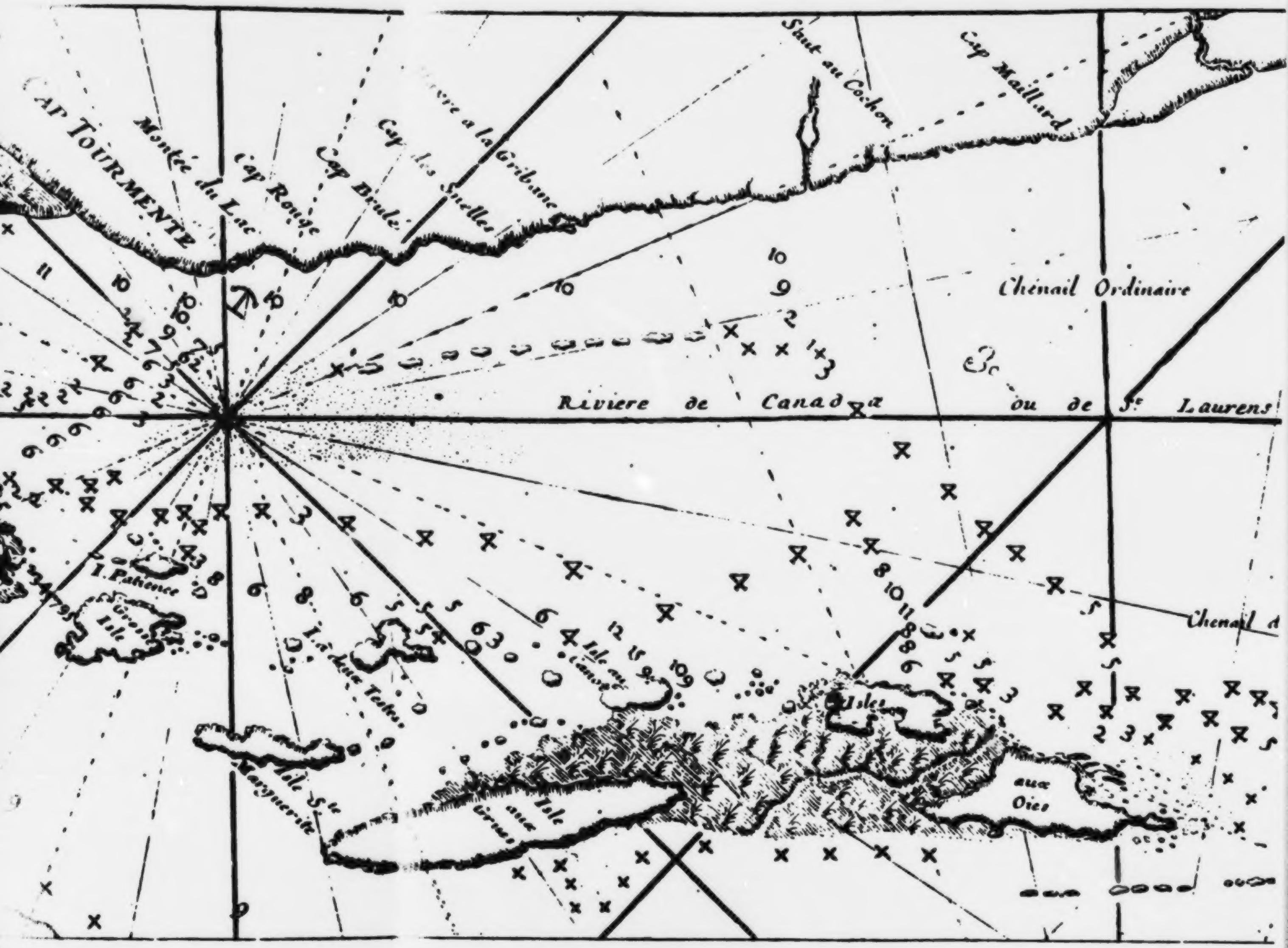
At this point in our narrative it may be helpful to revert to developments in France that provide the context in which the New World services of Deshayes were performed. J. B. Colbert had founded the Académie Royale des Sciences in 1666, a prime favorite of all the important projects instituted by him. The Academy was formed with one of its avowed purposes... "to correct and improve maps and sailing charts". In order to carry out such a program it was necessary to find some satisfactory method of determining longitude, especially while on the high seas.

The foremost European expert at the time in such matters was Jean-Dominique Cassini. As a leading Colbert recruit for the staff of the Academy he inaugurated, in the 1680s, surveying and astronomical observation work in many quarters of the globe by French scientists. Two of Louis the Fourteenth's commissioners or engineers of hydrography, Deshayes and Varin, were trained by Cassini at the newly-built Paris Observatory where the two young men could make trial observations in order to improve their survey methods. They received final instructions on their part in the world-wide plan for ascertaining longitudinal positions, namely, to proceed to the island of Gorée (near Dakar) and the West Indies. This was a particularly demanding and important assignment since their work involved the long crossing of the Atlantic on whose broad reaches the most disturbing errors had taken place in the fixing of longitude lines.

Deshayes and Varin had taken with them an assortment of interesting scientific instruments including a large quadrant, pendulum clock and a 19-foot telescope as well as a thermometer, barometer and compass. They were at Gorée in March, 1682, and returned in the following March to Paris, after observing eclipses of the satellites of Jupiter in an effort to fix correct lines of longitude. Also as part of their instructions they were to observe and record compass variations as well as gathering data on the behavior of clock pendulums in latitudes close to the equator. The pendulum actions seemed to support the Newtonian theory of a diminishing gravity force within the areas


ISLE D'ORLEANS
St. François
St. Joachim
Butte
Prairie
CAP TOURMENTE
Montée du Lac
Cap Rouge
Cap Brulé
Havre a la Gribane
Riviere de
Isle au Rots
Isle Madame
I. Patience
Grosse Isle
St. Laurens
Chenail d'Hiberville
Berthier
Isle Ste Marguerite
Isle aux Grues

MAP 21. Insert on a map based on Deshayes 1685 surve, ne St. Lawrence. Courtesy of the Public Archives of C


Cap Tourmente
Montée du Lac
Cap Rouge
Cap Brulé
Cap des Snelles
Riviere a la Gribane
Saut au Cochon
Cap Maillard
Chénail Ordinaire
Riviere de Canada ou de St. Laurens
I. Patience
Grosse Isle
La deux Testes
Isle aux Canots
Isle Ste Marguerite
Isle aux Grues
Islet
aux Oies
Chenail d

on a map based on Deshayes 1685 survey of the awrence. Courtesy of the Public Archives of Canada.

in which the earth bulges out. These activities in Africa and the West Indies extended over 1681, 1682 and 1683 and won for Jean Deshayes a firm place in the scientific hall of fame.

His health improved greatly during the winter months in Canada in 1685-86 and in the spring he was supplied with a barque for surveying the Gulf, "s'est fort promené le long des rivages du fleuve au-dessus de Québec, en attendant que la navigation fut ouverte pour descendre à l'embouchure". That part of the Gulf of St. Lawrence appearing on the chart he produced was evidently surveyed during the summer season of 1686.[9] In the autumn Deshayes returned to France to . . . "rendre compte . . . de son travail". Though much of the Gulf remained uncharted he did not return to Canada for some eighteen years.

In 1704 Deshayes was back in New France with greatly enhanced prestige and position. He began working again on his long-unfinished Gulf of St. Lawrence chart, including a part of the Labrador coast. By 1706 Deshayes was either giving or preparing to offer lessons on pilotage at Quebec but his death intervened on December 18th of that year. There are files of notary de la Cotière in storage in the Court House Archives in Quebec that include a long inventory of his effects as of December 22, 1706. This inventory refers, among other items, to a collection of surveying instruments and to forty volumes on surveying and navigation, some of them borrowed from the Jesuit Fathers. It was not until November, 1707, about a year later that the Minister in Paris, de Pontchartrain, learned officially of the death of Deshayes.

The eminent cartographer left a useful legacy of maps to his fellow-Frenchmen and fellow-Canadians. In addition to his "Carte de la Rivière de St. Laurens" and his "Carte des Côtes habitées du Canada par Paroisses et par Seigneuries" both dated 1686, Deshayes is best known in New World cartography for his "La Grande Rivière de Canada (Appellée par les Europeans de St. Laurens)" of 1695 and his "Côte de Labrador" of 1704.[10] Deshayes conducted, on a truly scientific basis, one of the New World's earliest important hydrographic projects, that of the St. Lawrence River basin and he was one of the founders of functional surveying in this country. Deshayes bestowed increased stature and prestige upon the title of Royal Hydrographer, making it significant in terms of actual surveying practice. Even so, up to 1750 no systematic harbor soundings had been made in more than a dozen Gulf of St. Lawrence ports.

The labors of Fathers Dablon, Allouez and Marquette, along with the explorations of Brulé, Nicolet, Radisson and Groseilliers demonstrated to the world that there was no east, direct route to the Western Ocean after leaving the Great Lakes. For it had been a rather widely held assumption prior to about 1660 that such an ocean could be reached just west of Lake Superior. Now the conviction was steadily growing that there was, in fact, a vast land-mass intervening. The Jesuit map of 1672, the result of more than thirty years of Jesuit exploration, was particularly useful in its portrayal, for the first time, of rivers leading west from Lake Superior to the country of the Sioux, as well as its presentation of the complicated bays and islands on the north side of the lake, including the Nipigon River leading into Lake Nipigon. On this map Lake Superior is styled, "Lac Tracy ou Supérieur". The amount of detail indicates that Jesuits had explored every part of this inland freshwater sea and had a good knowledge of the straits connecting the three Upper Lakes as well as the shorelines. In addition to maps drawn for publication in the Relations, Jesuits such as Father Fénélon with his map of the Bay of Quinte; Father Raffeix and his map of New France extending from the

Atlantic to Lake Erie and a map of Lake Ontario with surrounding regions; Father Aubry's 1713 map of Acadia*, Father Laure's map of the Royal Domaine — all contributed to the mounting treasury of cartographical material originating in New France.

In the St. Lawrence basin it was becoming obvious that in some important respects the colony needed navigators, engineers, mappers and surveyors during this formative period more than it needed artists, men of letters or even politicians. It is not surprising, therefore, to learn that the King maintained at Quebec in addition to a Royal Hydrographer, a surveyor whose duties involved both the making of surveys and the drafting of plans. A protégé of Frontenac, an engineer named Raudin, took a special interest in mapping, but information about him is sparse. Parkman ventures the opinion that Raudin may have drawn the map titled, "Carte de l'Amérique Sept-entrionale depuis l'embouchure de la Rivière St. Lauren jusques au Sein Mexique" now in the possession of Depôt des Cartes de la Marine et des Colonies, Paris. Raudin was succeeded in 1685, at least for a limited time, by the military engineer, Robert de Villeneuve.

When Jean Deshayes died, late in 1706, the Governor of the colony, Phillipe de Rigaud, Marquis de Vaudreuil, and the Intendant pleaded with home authorities to request that the Jesuits "take the place of Sieur Deshayes". This time Louis the Fourteenth yielded to pressure. Since the first appointment of Franquelin 22 years had elapsed. More than 70 years had gone since the death of Champlain. For the next half-century (1708-59) a succession of Jesuit Fathers carried on at the Quebec College as Regius Professors of Hydrography.[11]

In 1717 the Marine Council advised the Governor and Intendant that the Jesuit professor who taught hydrography at Quebec was entitled to issue certificates licensing young men as pilots on completion of the required courses. These certificates were to be paid for by the recipients. The professor also had the right to issue licenses certifying that the bearer named therein had all the necessary training in theory and practice to enable him to carry on surveying efficiently and reliably.[12]

Jesuits who came from France to Quebec for the special purpose of teaching in hydrography included Fathers François Le Brun (1708-21); Charles Messaiger (1722-23 and 1736-41); Joseph Deslandes (1726-36) and Joseph-Pierre de Bonnécamps (1742-59). Others who deserve mention in this connection are Fathers Raffeix, Allioux, Lauzon, Silvy, La Chauchetière and Guignes. The salary during this period for the work of the professorship was set at 800 livres per annum.

Father Charlevoix had been instrumental in securing the appointment of Father Bonnécamps who came from France under obligation to take charge of the class in hydrography at the Jesuit College. The new professor soon discovered that the equipment available at the institution was inadequate for proper instruction, and applied to the home minister, M. Hocquart, for more and better instruments. M. Hocquart submitted a petition to the French Court, suggesting that it would be relatively easy and exceedingly useful to install on the college roof an observatory costing not more than 1200 francs. The requested instruments failed to arrive as expected and in 1748 Intendant Bigot returned to the assault on ministerial citadels. Finally the minister, at the end of 1749, just ten years before the transition to the British regime, sent out a second-marking clock, a telescope and a portable quadrant, among other items. Shortly before this happened, Father Bonnécamps had been instructed by Comte de la Galissonière (interim administrator of New France and curator of the map archives) to accompany a party despatched to take possession of the Ohio River Valley for France. That party was in charge of Céloren de Bienville and the Jesuit professor was to provide the skill in mathematics required to plot positions and to do mapping. On his return to Quebec early in 1750, Father Bonnécamps found that the instruments he had asked for so long ago, had at last arrived. He was heard to remark bleakly that his observations on the long journey had lacked something in precision for want of a quadrant. Several years later there must have been some comfort for him to report that at Fort Frontenac (Cataraqui) he had checked the latitude "with a quadrant which the Minister has had the kindness to send me".[13]

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*Father Aubry's map was used as a reference in the negotiations leading to the Treaty of Utrecht.

Father Bonnécamps being absent in 1753, Father Billard on July 27th was named Royal Geographer in the interim. In 1757 Father Bonnécamps applied for leave of absence and went to France, returning in 1758. In the interval, on November 27th, 1757, Sieur Pellegrin was appointed professor of hydrography in his place. This turned out to be the last such nomination under the French regime. On September 14, 1757, the office of Royal Hydrographer ceased to exist. After an additional year of professorial work at the College, Father Bonnécamps left Canada for the last time. He had held the post of Hydrographer at Quebec for the better part of 17 years (1742-59), a period longer than any of his predecessors in that office. A map which he made to accompany the text of his Journal was lost as well as astronomical instruments he had collected over the years. The map was in the archives of the Marine Ministry in Paris until it mysteriously disappeared in 1892.[14] It had been drawn in connection with the Ohio Valley expedition. His Journal of these explorations, including journeys to Cataraqui, Niagara, Detroit and the Ohio River, was not a strictly chronological account but a narrative divided into legs or stages of his travels.

It is apparent that from the opening of the Collège des Jesuites de Quebec in 1635 until the end of the French regime in 1759, a period of 124 years, the European influence in Quebec in surveying and mapping was completely French in character. It was an influence shared by the Jesuit Fathers in the colony with the Ministry of the Marine in Paris. The latter body recommended for appointment, if it did not actually appoint, teachers of hydrography and the Fathers determined the nature, scope and application of the courses to be given, the procedures followed being similar to those of Jesuit institutions of education in France itself. Long before Jean Talon began to dream of a marine academy in the New World the Jesuits were teaching mathematics and hydrography. Thus Father Germain wrote in 1711, "In regard to the college of Quebec it is just like our colleges in Europe, both in what it is and in what it does".

From 1686 to 1707 preference in the selection of hydrography teachers was shown to cartographers. From 1708 ability to teach the subject was also given serious consideration along with greater emphasis on academic qualifications. The excellence of the instruction and the zeal and ability of the college professors was so outstanding that even after the fall of Quebec there may have been a definite influence exerted on French mapping and surveying by the example and experience of the institution at Quebec. Father Bonnécamps, on returning to France after the transfer of Canada from French to British administration, went to the staff of a Jesuit college at Caen, a centre possessing a good reputation for instruction in science. His career as a teacher of mathematics there was terminated abruptly by the 1763 expulsion of Jesuits from France. When the Peace of Paris in February of the same year restored the island of St. Pierre to France Father Bonnécamps was appointed chaplain there by a Marine Ministry with a retentive memory and a sense of gratitude.

After the suppression of the Jesuits generally by the official decree of Pope Clemens XIV in 1773, Admiral Ollivier de Trongolly offered him the tutorship of his children.

During his closing years Father Bonnécamps lived at the chateau of Trongolly in the Black Hills of Finistère, dying there in the 1790s, well over the age of eighty. In all of his New World travels Father Bonnécamps wrote a Relation as well as a Journal. The Relation, in fact, is a letter he wrote to La Galissonière when forwarding his Journal and map dated October 17, 1750. The Relation gives a logical, as well as chronological, account of his journeyings. In the Journal Father Bonnécamps did his best to determine his positions accurately.[15] For each stage the routes followed, as well as the directions and distances involved, are set forth along with the latitudes and longitudes of salient points. The latitudes are given to the nearest second of arc. It was his custom to view from time to time his "butterfield" (Journal, p.58) meaning the compass of his butterfield (the portable sundial with gnomon mounted on a compass). This instrument was in vogue in the early 1700s, and continued in wide use for most of the period during which Father Bonnécamps was the dedicated and worthy leader in the mapping and surveying of New France.

9

SEIGNIORIES AND SURVEYS

The seigniorial system of land tenure, as established in New France in Champlain's time, provided a chain of colonial responsibility linking the lowliest subject of the state to its sovereign head. Canada had become, through the daring of French explorers, an overseas dominion of the King of France. Accordingly it was part of the royal prerogative to grant lands and other privileges within its boundaries. Large grants of land were made by the King directly, often to men of the nobility but sometimes to members of the yeomanry or of the farming classes. Grants were made also through the King's personal representatives in the New World or through large trading companies formed to develop French colonies.

Grants of seigniorial land were made on specified conditions. First, there was the obligation of fealty and homage to the Crown. Second, there was the obligation to perform military service when required and thirdly, there was the persistent need to settle and develop the land itself. The grantee from the King (the seignior) was under obligation to parcel out his seigniory in relatively small individual farms. The farm occupant was a tenant or *censitaire*, the term deriving from "cens" signifying an acknowledgment of domain, a sort of quit-rent. The *censitaire*, in turn, rendered homage and rental amounts to the seignior.

Probably the first reference made to application of the principle of seigniorial tenure to Canada was in the commission given by the King to a Breton nobleman, Sieur de la Roche, conferring on him in 1598 the title of lieutenant-general of French possessions in North America and with "authority to . . . grant (lands) to all whom he considers persons of merit, in the form of fiefs, seigneuries . . . on condition they shall aid in the support and defence of the territories . . . to others on such dues and annual rentals as he may deem just".[1] This commission was given a quarter-century before

Cardinal Richelieu rose to political power in the realm. The de la Roche experiment in colonization came to nothing.

The first mention of actual grants of seigniories in New France occurred in the 1620s. These first grants, naturally enough, were made in the vicinity of the larger centres of population and on the north side of the St. Lawrence River. The settlement process under this pattern of progress proved to be surprisingly slow. Up until 1634 only three seigniories had been established, two granted to colonial laymen and one to a clerical order, the Society of Jesus.

In 1626 Louis Hébert received his Sault-au-Matelot grant, the earliest seigniory in Canada. The grant was made on February 4, 1623, by the Duc de Montmorency and confirmed on February 21, 1626, by the Duc de Ventadour.[2] But Hébert never did exercise any seigniorial rights or authority over his bush lot of 10 square arpents. Guillaume de Caen, a Huguenot trader, was granted a seigniory a year or so later at Cap Tourmente. At about the same time the seigniory of Notre-Dame-des-Anges was bestowed upon the Jesuits. All three holdings were located near Quebec. Not until eight years later was another grant of the kind made. In 1634 Robert Giffard, a surgeon, was granted a seigniory "one league wide and one league and a half deep" at Beauport by the Company of One Hundred Associates. Giffard was the first genuine seignior in New France and was very much in earnest over the fulfilment of his obligations. The grant he received had a three-mile frontage along the St. Lawrence River and in 1634 he brought from his native Montagne in France forty stalwart future inhabitants. It was their task to clear and cultivate this rather choice land. He ceded the fief (dependant area) of Buisson to Jean Guyon, a mason, and the fief of La Clouterie to Z. Cloutier, a carpenter. Soon the first seigniory village in New France was in the making.

Jean Bourdon was at least nominally a beneficiary of the seigniorial system. There is no evidence that he profited from his holdings. In the course of a quarter century (1636-1661) he or his family were allotted no less than six seigniories. The first (La Rivière-au-Griffon) was granted by Governor de Montmagny on July 30, 1636. The second (Dautray) was a grant from the Company of New France on December 1, 1637. The third (Dombourg or Pointe-aux-Trembles) was granted on December 15, 1653, for his son Jean-François. A few days later, on December 21, the fourth (La Malbaie) was granted by Governor de Lauzon in the name of the Company of New France. The fifth (Saint-François) was granted on April 25, 1655, and the sixth (Saint-Jean) on March 19, 1661.[3]

The allotment of seigniories, in turn, involved the establishment of land boundaries. The precise method followed by surveyors in laying out these lines is never made clear in any existing documents. The contents of a deed dated more than a half century later than the period with which we are dealing, sheds some light on surveying procedures of the early 18th century in New France.

"In 1726, March 11, at the request of M. de Ladurantaye, Seigneur of Kamouraska, and of all people living in the said Seigniory of Kamouraska, I, Noel Beaupré, a commissioned surveyor in the Nouvelle-France, undersigned, have on purpose come to the said lands of Kamouraska and on being there, I started from the line which is between Gabriel Paradis and Pierre Roy dit Degeardins, in the presence of my said Sieur de Ladurantaye and of Sieur Sanssoucy. . . . I have chained northeastwards 4 arpents less a perche for Gabriel Paradis, 3 arpents 4 perches for the widow Laplante, 3 arpents 6 perches and 12 feet for Pierre Beaulieux. . . . Which I separated by parallel lines which lay in the southeastward-northwest direction with a deviation of 16 degrees; and on each of them I set up two boundaries of stones, with bricks, clinkers and pieces of earthenware pots, in the presence of the said Sieur de Ladurantaye who has signed, and of the above-mentioned Gentlemen who declared they don't know how to write their names . . ."

We know from descriptions given by Samuel de Champlain that sundials and marine compasses were in fairly common use in the earliest days in the colony and it may be assumed that in surveying work some type of chaining or pacing was employed to mark off lineal distances. Apparently there was a custom among pioneer surveyors to add a rod on each lot measured. This customary addition was referred to as "le robinet" or "le retour du baton" and was devised in order to make certain that the property owner was not being deprived of any land rightfully his. There may well have been in use also something resembling the "wyer line" as known in England in the 16th century. It is hardly surprising that, in relying on relatively primitive instruments, the work of the early land measurers of New France was less than perfect. Boundary disputes arose in the mid-17th century in the colony. For example, in the reports of the Superior Council of New France in 1664 the following entry occurs for August 20th:

"Guillaume Bonhomme et Jacques Bertheume demandeurs Eustache Lambert fermier de la terre et Seigneurie de laisson defendeur. Party es ouiges le Conseil a ordonne que le sieur Dombourg se transportera sur les lieux en litige pour mesurer et arpenteur deux arpents au dessus de la pointe qui est en la dicte seigneurie laquelle regarde la d'icelle R^{e} du cap rouge Et Luict arpents, au dessus d'icelle pour estre dans le dict espace de terre faict pesche d'anguille par les demandeurs au desir du bail notaire 20 juillet".[4] "Guillaume Bonhomme and Jacques Bertheume, plaintiffs; Eustache Lambert, farmer of the land and Seigniory of . . . defendant. Both parties having been heard the Council ordered Dombourg to go to the places in dispute in order to measure and survey two arpents from the point which is in the said seigniory facing . . . Cape Rouge . . . and eight arpents from this one so that the plaintiffs (can) fish eels in the said area according to the lease executed and authenticated by notary, July 20." It will be recalled that not later than 1674 disputes between land-owners arose in the colony because of discrepancies between compasses and other instruments used by surveyors in measuring individual plots and that these instruments were required by law to be tested and corrected by Martin Boutet. This law applied to newly-appointed surveyors as well as the veterans.

In France the homeland, surveying as an occupation had steadily grown in stature and prestige. This development, in turn, was reflected to some extent in the New World. In the mid-17th century land surveys commenced in the Montreal region. Deeds of plots were drawn up as early as January, 1648. But who made the surveys? The name of Gilbert Barbier appears on records in this regard. Certainly he was practising surveying by 1684. In earlier years it is more likely the surveying tasks were performed by Sieur de Maisonneuve who gave the impression of great versatility. He administered the seigniory, acted as the garrison's commandant, presided as a judge and drew up contracts. Being an officer of fairly high rank he would know something of geometry and the rudiments of surveying. As far as can be discovered no surveyor actually studied and trained in surveying at Montreal (Ville-Marie) before the time of Bénigne Basset. We know that on June 8, 1663, Sieur de Maisonneuve, in the presence of property owners, ordered the placing of boundary markers on any unbounded concession. A few days later, on June 14, M. Basset was instructed to survey each property owner's land and install boundary posts. Ten years later, in a document dated November 28, 1673, Basset signed as "first surveyor of the Seigniory of Montreal" indicating that he had received an official appointment to that position.[5]

In the Old Land surveying received its first important official recognition when Henry II of France in 1554 appointed an official of his court to be "Arpenteur Royal" or "Surveyor to the King". The word "arpenteur" is derived from the measure "arpent", unit of length and area found in the French system. The Arpenteur Royal delegated powers to subordinates in each judicial district. These junior officials were required to have a fair practical knowledge of arithmetic, geography and mensuration as well as a working familiarity with the general customs and property laws of their home districts. In 1668 Louis XIV discarded the title "Arpenteur Royal" and reserved to himself the right to appoint surveyors. To those so honored he awarded diplomas following assurance from his advisers of the fitness of the surveyor for his office. The King also instituted oaths of office and enjoined the oath-takers to conduct themselves strictly by law and conscience under penalty of the loss of their commissions. These officers were known as "Arpenteurs jurés" or "sworn surveyors" and were obliged to measure lands and to settle disputes between owners. One of them was chosen by the disputants or by a court of justice to establish the lay-out of properties involved in the quarrel and for the fixing of permanent boundary lines.

These basic innovations in procedure and organization took place in the same year that Jean Bourdon died in New France (1668), the year that Father Allouez discovered Lake Nipigon and Jolliet was preparing to penetrate westwards to the Niagara country. It was the same decade that Sieur de la Salle arrived in Canada and that Hudson Bay was reached overland by Radisson and Groseilliers. It was also the decade in which Molière wrote his first play (1662). Only a few years later the Sulpicians were granted a seigniory at Montreal, the island on which Paul de Chomedey, Sieur de Maisonneuve had founded a settlement a quarter-century earlier.

In its role as a feudal overlord the Company of New France had granted large tracts of land *en seigneurie* to persons of some substance and standing on the condition that they settle the property with colonists. Colbert's basic objectives for French America continued to be increased population and concentrated settlement. Despite all that he or his officials in New France could do to alter the trend, settlement continued to follow the basin of the St. Lawrence River. From 1666 to 1676 most, if not all, seigniorial grants were made by the Intendant. Talon, just before his term of office expired in 1672, made sixty grants of seigniories. Of these sixty a few fronted on the Richelieu River but by far the largest number were located on the St. Lawrence between Quebec and Montreal. The habitant farms into which these seigniories were divided as development progressed consisted of narrow strips following the general outline pattern of the seigniories. Settlers avoided rear locations, away from the riverfront. The tendency, therefore, was to sub-divide in the same general shape as the dominant or parent grant.

It is an exercise in futility to try to trace the institution of the oblong habitant farms or seigniories to any individual, although Sulte attributes the principal credit (or blame) to Jean Bourdon. In several respects the special shape of these Canadian land holdings of the early 17th century was dictated by natural environment. Long and narrow properties enabled the greatest number of settlers to have easy access to main river courses, the water highways and chief communication links of the times. There were other advantages also, such as proximity to neighbors in case of Indian attacks, as well as nearness for purposes of sociability.

In the light of conditions peculiar to the Canadian scene, the pattern of square or rectangular holdings adopted in the English colonies to the south did not seem to meet the needs of Quebec colonists. Flowing from southwest to northeast the St. Lawrence River bisected the areas best suited for cultivation. In order to establish a dominant geometrical design of land holdings it was essential that the property boundaries be arranged along the directional lines dictated by the presence of the river. Thus we find long, narrow river lots arranged generally in a northwesterly, southeasterly configuration.

In Colonel Joseph Bouchette's *A Topographical Description of the Province of Lower Canada* (1815) there is an interesting reference to a provision that "most of the seigniorial lines of the province ought to run northwest and southeast, reckoning from the astronomical meridian" . . . in conformity to an ancient ordinance of the province, namely an "arrêt et règlement du conseil de Québec" dated May 11, 1676. A careful search of Quebec provincial archives has failed to uncover such an ordinance although it should be added that the records of that year in the possession of the archives are incomplete.

Many traces of this distinctive pattern of land holdings may be found in modern cartography portraying the province of Quebec. Present-day outlines of Montcalm, Joliette and Berthier counties derive, for example, from the manner in which the original seigniories in those areas were laid out. There were exceptions to the general rule, of course. Rivers such as the Ottawa and Richelieu dictated certain departures from the normal arrangement as did the presence of Lake Champlain. Even along the St. Lawrence River not all seigniories are oblong in shape. Some are square or nearly so. In the main the exceptions are to be found in areas remote from rivers and where hilly country requires the establishment of property and seigniorial outlines other than the oblong type. Some of these rear seigniories resemble in shape an elongated trapezoid. The seigniory of St. Gabriel is a case in point. Or they may be found in the form of an irregular triangle such as the seigniory of Bourgmarie.

Not all parallel properties were of uniform width. The Company of One Hundred Associates and the state itself did not always grant exactly similar amounts of land in each seigniory. Large seigniories are relatively few and include Beaupré, the Island of Montreal, Batiscan and Cap-de-la-Madeleine, all of which extend at least 20 leagues into the interior. Lauzon, another extensive grant, extends for 36 leagues. All of these larger seigniories were granted in the early part of the 17th century. After 1695 the seigniories became much smaller. The main exceptions to this later policy included Beauharnois in 1729, Saint Hyacinthe in 1748 and Rioux in 1751. Viewing the whole spectrum (and excepting the earliest grants) the smallest seigniory would be about a mile square; the largest 1,000 square miles.

The average size farm had a frontage of three or more arpents and by a depth of thirty or more arpents, but here again there were variations. Although the frontage and depth lines of the first range or tier of lots usually followed the sinuosities of a river, nevertheless a straight line was generally drawn to mark the frontage of the second range so that a geometrical pattern would result. Where boundary lines failed to meet evenly the surplus strips of land between the ranges "abouts" *(gores* in the English terminology) were allotted to *censitaires* or tenants in the form of additional acreage. Once the first range of land holdings had been settled the seignior placed tenants on the second range, and so on. Cultivation continued to be the principal goal of settlement. In 1711 Louis the Fourteenth served a reminder to colonial authorities by an order to abolish all seigniories in which the title-holder had neglected land development. This was not an empty threat. In 1741 alone, eighteen seigniorial grants were revoked for non-observance of this requirement.

The grant of the seigniory at Beauport to Robert Giffard was soon followed by similar grants, most of them located near Quebec. From 1635 to 1645, however, settlers pushed steadily along the north shore of the St. Lawrence beyond Three Rivers, a settle-

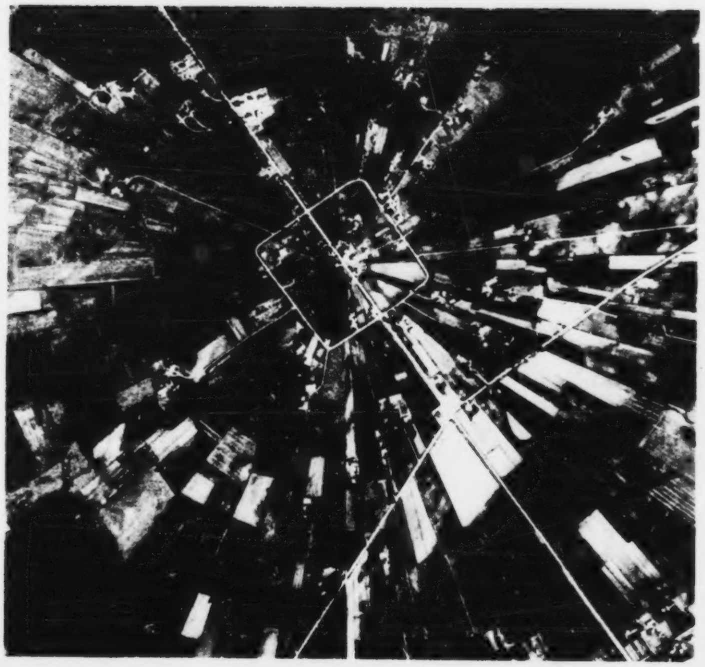


FIGURE 10. Airphoto of present-day Bourg-Royal, near Quebec City. The village is in the form of a square of 40 arpents a side (c. 1 ½ miles). Each side forms the bases of 40 triangular-shaped farms of 40 square arpents (34 acres). In case of sudden Indian attack the pioneer settlers could speedily reach the fortified central square, shown bounded by a roadway.

ment established, as we have noted, in 1634. After the founding of Montreal in 1642 some seigniorial concessions were made in the area surrounding the confluence of the Ottawa and St. Lawrence Rivers. From 1634 to 1663 at least sixty seigniorial grants were made by the Company of One Hundred Associates. But along the entire south shore of the St. Lawrence there was hardly a farm to be seen during this period. Dissatisfaction with the company's dismal record of settlement led to the cancellation of its charter and to the substitution of a new form of civil administration in the colony including a Council, a Governor, Bishop and Intendant.

In 1665 the King sent to New France the Carignan-Salières regiment, a display of military power calculated to help over-awe the menacing Iroquois. After this unit had completed two years of service in New France, Intendant Talon proposed that officers of the regiment should be allotted generous tracts of land in the colony as an inducement to settle, such lands to be held as seigniories, and that each officer should be required to sub-grant parts of his grant as farms within the seigniory to such non-commissioned officers and men as might wish to remain in Canada. The King approved this inspired proposal and about 25 officers and some 500 non-commissioned officers and men proved willing to stay on in the colony. Authorities decided to locate most of these soldier settlers along the Richelieu River or near to it. Most of the title deeds related to these transactions are dated 1672. For example, a seigniory was granted under the arrangement to Sieur de Saurel, captain of the regiment, being a tract of land at the confluence of the Richelieu and St. Lawrence Rivers where now stands the city bearing his name in somewhat modified form. The settlement of the military in New France stimulated the seigniorial system generally as well as agricultural development in the colony.

During the last quarter of the 17th century seigniories were awarded in the colony with a lavish hand. Upwards of ninety grants were made. Undoubtedly abuses occurred in the distributive process. Because of certain excesses and other factors an official re-examination of the whole system and of its operation became imperative. At this juncture in the colony's affairs a man was found, qualified by experience, training, ability and temperament to undertake a thorough-going survey. Gédéon de Catalogne (or Catalougne) was born in Bearn, France, in 1662. At an early age he enlisted in the French army engineer corps and quickly rose to the rank of lieutenant. He was a Huguenot and when the Edict of Nantes was revoked in 1685 he found that he had to renounce his faith or leave France. He chose the latter course and emigrated to Canada only to reverse his decision and, in due course, become a Roman Catholic.

De Catalogne led an eventful life in New France. He was one of the leaders of the 1686-87 expedition sent by the French against the English posts in the Hudson Bay area. Later he showed great gallantry in helping with the defence of Montreal settlers against Iroquois attacks. In 1690 he was placed in charge of work designed to strengthen the defences of Quebec. In 1700 he supervised a canal project at Lachine. In despatches to the minister in 1708-09 de Catalogne's zeal, industry and ability were commended warmly by Intendant Jacques Raudot who also transmitted to Paris maps of the Montreal, Three Rivers and Quebec areas which de Catalogne had prepared with special care and accuracy. In 1711 he resumed the task of improving Quebec's fortifications and six years later was appointed to supervise engineering work at Louisbourg, where he was stationed until his death in 1729.

The three maps ostensibly forwarded to France were prepared in connection with a request of the Intendant directed to de Catalogne to make a report on the state of the seigniories in New France. The result of this survey was a lengthy document entitled, "Mémoire sur les plans des seigneuries et habitations des gouvernements de Québec, les Trois-Rivières et de Montréal", dated at Quebec, November 7, 1712.[6] The assignment required two years to carry out. Though the writing lacks literary style this massive document is of the highest historical value, revealing in reliable detail the development stage reached by the various seigniories during the early part of the 18th century. Only two of the three Canadian districts represented by de Catalogne maps were later found to be recorded in this manner in French archival files. Maps of the Montreal district are still missing despite a diligent search for them by Canadian scholars through the important French archives. It is possible, of course, that the map or maps of the Montreal district were not forwarded with the others, or if so, may have been lost at sea.

In the Map Division of the Public Archives of Canada in Ottawa there are excellent copies of these 1709 maps, five in all, three of the Quebec district and two of the district of Three Rivers, complete with seigniory outlines and map scales. They appear to have been drawn by Jean Baptiste Decouagne based upon the surveys of de Catalogne. The inscription on one of them is: "CARTE DU GOUVERNEMENT DES TROIS RIVIÈRES QUI COMPRENT EN DESCENDANT LE FLEUVE ST. LAURENT DEPUIS LA SORTIE DU LAC ST. PIERRE JUSQU'À STE. ANNE. LEVÉE EN 1709 PAR LES ORDRES DE MONSEIGNEUR LE COMTE DE PONTCHARTRAIN, COMMANDEUR DES ORDRES DU ROY MINISTRE ET SECRÉTAIRE

DESTAT PAR LE SR. CATALOGNE LIEUTENANT DES TROUPES ET DRESSÉE PAR JEAN BAPTISTE DECOUAGNE".[7]

Upwards of 90 seigniories were considered in the survey and report. Each is described in painstaking detail. Some sweeping conclusions were reached. It was evident from the examination, for example, that so much land had been granted that even four times the amount of available farm labor in the colony could not have cultivated the area properly. An excess of holy days during the relatively brief crop-growing season unduly reduced working time in the fields, de Catalogne found. The attractions of the profitable fur trade served to undermine the farming industry. De Catalogne proposed that the *grand voyer* (chief road supervisor) be instructed to proceed with greater zeal in the construction of roads and bridges. The streets in Montreal and Quebec, according to the author of the report, were so full of boulders and mud-holes as to be impassable. He recommended that a fund be set up for the improvement of roads.[8]

In the matter of land boundaries de Catalogne reported with obvious spirit and emphasis. If His Majesty desired "to root out a hotbed of strife and bad feelings between seigniors and their dependants, he will take measures to ensure peaceable possession to those settlers who have held their lands for long periods in good faith, and *this* without too much regard to the *exact boundaries* as these may have been defined in the original title deeds" (author's italics). De Catalogne asserted that the whole question of property boundaries was in hopeless chaos (1712) and since surveying had been done by unskilled persons, any attempt to adhere rigidly to the lines laid out would only mean a victory of chicanery over justice but in some cases at least would encounter physical impossibilities. Catalogne was not the only critic who deplored the haphazard way in which metes and bounds had been laid out in New France and the resulting flood of ill-tempered controversy over demarcation lines and posts. But his complaints won a wider and more attentive audience. Incidentally, of the three main classes of seigniories—ecclesiastical, military and secular — de Catalogne found that the church-owned lands were among the best cultivated and best managed properties as well as the least afflicted by trivial disputes.

It is likely that the de Catalogne report influenced the final decision of French authorities in the homeland to institute, a few years after the formal submission of the survey, far-reaching policy changes. Orders were issued to the Governor and Intendant that no further seigniorial grants were to be made in New France without the personal approval of the King. This order was apparently communicated to the Governor in June, 1716. Accordingly no seigniories were allotted in Canada during the decade 1717-1727. In addition vigorous measures were adopted to expedite the clearing of land. These steps resulted in a doubling of the cleared area within the ten years from 1720 to 1730.

When Colbert and Talon held office there was real concern in the governing circles in France over the popularity of the narrow oblong farms within the seigniorial boundaries. Talon's abortive efforts to alter the trend and to establish compact separated villages, rather than adhere to the concept of the endless main street along the river bank, have been recounted. In 1676 the King made one final attempt to bring about a distribution of population in the colony more amenable to efficient administration by ordering all seigniories in New France to be placed contiguously, and not scattered here and there across the wilderness.

Apart altogether from geographical considerations there were solid advantages of the seigniorial system of land tenure that won favor for it among the habitants. As adapted to Canadian conditions this essentially feudal structure possessed most of the

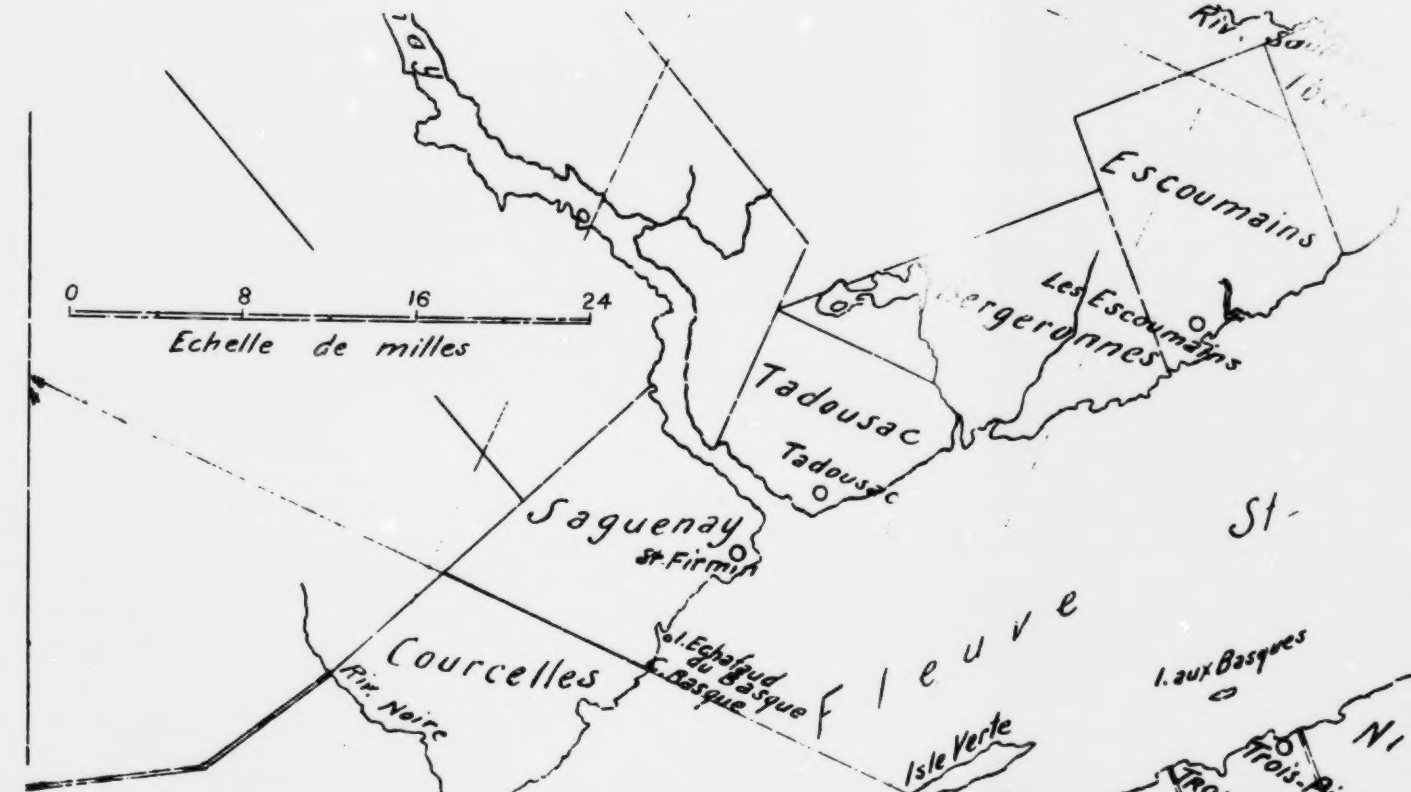
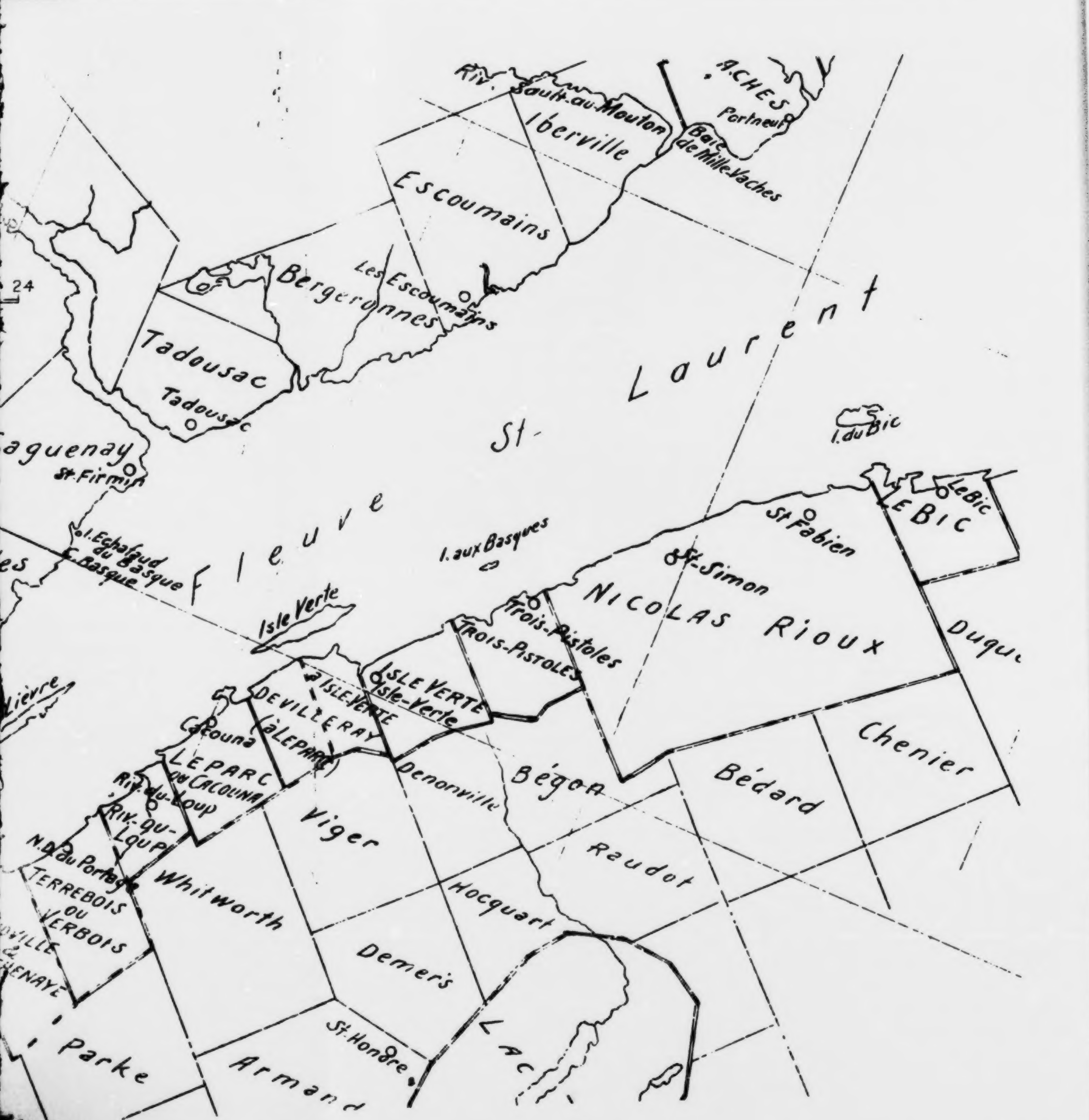

0
8
16
24
Echelle de milles
Escoumains
Les Escoumains
Bergeronnes
Tadousac
Tadousac
Saguenay
St-Firmin
St-
Courcelles
Riv. Noire
I. Echafaud du Basque
C. Basque
Fleuve
I. aux Basques
Isle Verte
Trois-Pistoles
TROIS-PISTOLES
ISLE VERTE
Isle-Verte
MOUNT-MURRAY
St-Siméon
St-Fidèle
Riv Malbaie
I. au Lièvre
DEVILLERAY (à LEPARC)
ISLE VERTE
Cacouna
LEPARC DU CACOUNA
Riv-du-Loup
Riv-du-Loup
Denonville
Bégon
Is Pèlerins
N.D. du Portage
TERREBOIS OU VERBOIS
Whitworth
St-André
GRANDVILLE & LACHENAYE
ISLET-DU-PORTAGE
Ste-Hélène
GRANDVILLE
Hocquart
Kamouraska
KAMOURASKA
St-Denis
ST-DENIS DE L.
St-Philippe
RIV-OU
Riv. Ouelle
Demers
St-Honoré
Parke
Armand
Bungay
Woodb

FIGURE 11. Seigniories on lower St. Lawrence River. From Manuel des Fiefs et Seigneuries, Arrière-fiefs. (Prov. Que. Bur. Cadastre, Que., 1923).



Riv. Sault-au-Mouton
Iberville
A.CHES
Portneuf
Baie de Mille-Vaches
Escoumains
Les Escoumains
Bergeronnes
Tadousac
Tadousac
24
aguenay
St-Firmin
Fleuve St-Laurent
I.du Bic
LeBic
LE BIC
St Fabien
St-Simon
NICOLAS RIOUX
Duqu
I. aux Basques
I. Echafaud du Basque
C. Basque
es
Isle Verte
Trois-Pistoles
TROIS-PISTOLES
ISLE VERTE
Isle-Verte
à ISLE-VERTE
DEVILLERAY (à LEPARC)
Cacouna
LEPARC ou CACOUNA
Riv.-du-Loup
Riv.-du-Loup
Lièvre
N.D. du Portage
TERREBOIS OU VERBOIS
VILLE
NAYE
Denonville
Bégon
Chenier
Bédard
Viger
Raudot
Whitworth
Hocquart
Demers
St. Honore
Lac
Parke
Armand

FIGURE 11. Seigniories on lower St. Lawrence River. From Manuel des Fiefs et Seigneuries, Arrière-fiefs. [illegible] Bur. Cadastre, Que., 1923).

merits and few of the defects of the system as it had developed in France.[9] The seignior was not the dominant lord, European version. In reality he was not much more than a senior tenant himself, owing duties to the King similar to the duties owed to him by the *censitaires*. Often a very fine, congenial spirit existed between the seignior and the habitants in the New World. The old order was feudal in theory and patriarchal in execution. But the seignior in Canada was neither an autocrat nor an absentee landlord. In rank he was not usually very far above his tenants. He participated actively, as a rule, in the hard labor of the community of which he was the nominal head. In a land subject to sudden, savage Indian raids as well as attacks from hostile whites, the system enabled the authorities to summon colonists to arms with relative rapidity. This purely military aspect of feudalism was a pronounced advantage under pioneering conditions. The economic burdens on the rank and file of the seigniory were never really onerous in their Canadian context, although complaints arose from time to time over forced labor drafts for such community projects as road-building.

The seigniorial system, with its chain of economic and patriotic responsibilities, gradually declined and came to an end in Canada in 1854. It had served its purpose well during the formative stage of the colony and, in any event, showed signs in the 19th century of becoming quite obsolete. The system lost its vitality and significance mainly because of the transition from French to English administration in Quebec and the consequent rise in the number of English seigniors. With this transition the spirit of the institution itself had undergone a radical transformation despite the continuance of the structure in its external forms and functions. The value of seigniorial land tenure to the growth of French Canada is best expressed in the words of W. B. Munro:[10]

". . . seigniorialism played a useful, even notable role in moulding the destinies of New France. It gave to the colony much of its vigour in arms and much of its characteristic aggressiveness . . . It did little, however, to expand the human faculties of initiative and enterprise in the arts of peace . . . Although not all the industrial stagnation which characterized New France from first to last may properly be laid at its door, the institution was unquestionably part and parcel of the general scheme of stifling paternalism which held the colony in its economic tutelage and it must therefore be debited with its share of the general outcome . . . The seigniorial system helped to make New France homogeneous, loyal to her church and her sovereign, and helped to give her a defensive strength quite out of proportion to her population and resources. On the other hand it retarded the march of the colony to material prosperity, hindered the development of moral and intellectual independence and interposed a formidable barrier to the institutions of free government".

10

THE AGE OF THE EARLY ENGINEERS: REDUCTION OF LOUISBOURG

"Let us survey the vantage of the ground . . ."
King Richard III, Act V, Sc. 3.

By the beginning of the 18th century France had built up an overseas empire that was the most impressive the world had seen up to that time. On the North American continent the French claimed, if they did not actually exercise, authority over the vast Mississippi basin, the Great Lakes region, the Upper and Lower St. Lawrence areas, Acadia and islands in the West Indies. The North Atlantic fisheries formed an integral part of this imperial domain. In appearance the empire was a majestic and awe-inspiring edifice but the passage of time and the force of events revealed it to be more facade than solid structure.

At home France was alert to the advantages of accurate surveys and mapping. A meridian line was run to the Pyrenees from Dunkirk and in 1718 a chain of 28 triangles was established from Paris to Dunkirk. Jacques Cassini, son of the illustrious Jean Dominique, calculated the value of a degree on the basis of the Paris-Dunkirk measurements as 56,960 toises. By 1733 the latitude and longitude of many points in the country had been redetermined, a clear outline of the nation was available along with a fairly accurate set of charts of its Atlantic coastline. A first-rate topographical map of Paris and vicinity was in print.

But France was not the only power in the Western World indulging in expansionist activities and increasingly aggressive national ambitions. In the half-century 1650-1700 Britain had achieved an entirely unprecedented position of power and prestige in Europe. Strengthened internally by constitutional revolution and consolidating against foreign threats by a union of the kingdoms of England and Scotland, Britain was experiencing a period of vigorous revival. Soon her impressive military triumphs in the Old World struck a shattering blow to the French possessions in the New. The Treaty of Utrecht, 1713, was a foreboding document for the imperial future of France. Within the span of the next half-century the imposing facade would crumble into debris and dust. But the vital flame of the French spirit in the New World, far from being extinguished by the cataract of violent events, was destined, in its Canadian setting, to cast a steadily increasing glow in the long years ahead.

Nor was England indifferent to the growing need to draw more accurate map lines across the earth's surface. In 1714 Parliament at Westminster by legislation provided "a publick reward for such person or persons as shall discover the longitude" including £10,000 for any practical device capable of determining longitude within one degree and £20,000 for any device determining longitude within 34 miles of being correct. The same legislation established a permanent body called the Board of Longitude to encourage these scientific efforts and to administer the prize monies. But another half-century was to pass before the longitude-finding mystery was adequately solved.

As the French population grew in the St. Lawrence basin, the work of surveying and mapping the land in advance of settlement kept pace with demands for these services. A study of seigniory documents and other ancient Quebec deeds reveals that from the beginnings of the colony it was considered essential by the people that each lot and subdivision of it should be surveyed, measured and bounded before owners entered into possession. Surveying tools at the time included portable box compasses, plane tables with alidades, odometers for measuring irregular lines, such as a river course, and semicircles for measuring angles.

Messrs. Buibuisson and Le Rouge, appointed by Talon, as well as Jean Guyon and François de la Joue (a Franquelin student) were among the outstanding land surveyors in the colony in the latter half of the 17th century. The busiest of them all, however, was one who was also qualified as an architect, Hilaire Bernard de la Rivière. From 1669 to 1725 la Rivière surveyed most of the government lands in New France.

In the first two decades of the 18th century the ranks of these pioneer surveyors were swollen by a number of talented recruits. In the summer of 1710 Jean Boutin was appointed a measurer and surveyor by the Intendant, on the recommendation of Sieur de Catalogne who was about to undertake his survey of the seigniories. The resulting 1709 maps of M. Decouagne are the best examples of settlement maps made during the French regime. Louis Quentin of L'Ange-Gardien in 1710 and J.-B. Pottier of Trois-Rivières in 1711 were other Quebeckers sworn in as surveyors. In the period 1711-30, ten additional surveyors were named, including Alexander Bourque of Port Royal in Acadia. Bourque also functioned as a judge and notary, having been appointed a surveyor on the recommendation of a Récollet missionary, Father Bonnaventure. Three years later, in 1714, Charles du Bled was appointed, followed by Noel Beaupré in 1718.[1] Beaupré became an exceedingly active and well-travelled land surveyor. In 1721, for example, he was pursuing his vocation energetically in the Gatineau region. Although he resided at l'Ancienne-Lorette near Quebec, Beaupré performed most of his surveying in the county of Kamouraska, some 80 miles distant. In 1726, in particular, he was in great demand in that area as he sought by his decisions to help mollify angry land owners disputing property boundaries.

During the last half-century of the French regime in Canada the name of Chaussegros de Léry was prominent in the engineering and mapping fields. Both the father, Gaspard-Joseph (1682-1756) and a son of the same name (1721-97) practised the same profession. Many of their maps and plans, a number of which relate to fortifications, are in the Quebec and Ottawa Public Archives. The father came to Canada from

France in 1716 in order to design and supervise construction of various military and civil public works. His career extended over 40 years despite occasional stormy relations with Governor Vaudreuil and Intendant Bigot. In 1742, for example, the plans of a new dry dock and new shipbuilding yards on the St. Charles River at Quebec were drawn up by him.

The son was also actively associated with military organizations and undertakings. He was made a lieutenant in 1748 and sent to Detroit the following year to make astronomical observations. He was promoted to captain in 1757 and worked during that year on Quebec fortifications. For a period he was a Grand Voyer and a member of the Executive and Legislative Councils of the province. In 1748 he was relieved of his position and Sieur de Couagne was sent from Louisbourg to be Assistant Engineer in his stead. Because of the duplication of Christian names the son signed some maps in the unusual manner "de Léry fils" which, in the English fashion, would correspond to "de Léry Junior".

In the first half of the 18th century in New France a growing trend to specialization became evident in the twin fields of surveying and mapping. Draftsmanship revealed increasing skill, especially in portraying details. In addition to the de Lérys, père et fils, there was Levasseur de Néré, known to have performed excellent work as a draftsman of plans. Several of these drawings are in the possession of the Map Division of the Public Archives of Canada, dated 1700, 1704 and 1709.

Louis Franquet (1697-1768) was a highly esteemed military engineer and draftsman who produced his best work in this pre-Louisbourg period. Some experts value his plans, for perfection of workmanship, above those of Verrier or the de Lérys. In 1750 Franquet was appointed "ingénieur français inspecteur des fortifications et des travaux militaires". In addition to his activity at Quebec he is known to have been in Louisbourg in 1751 and again in 1754, when that fortress was being improved.

In this same half-century the most impressive cartography of New France, as distinct from engineers' plans or surveyors' sketches, was produced by Jacques-Nicolas Bellin (1703-72), a geographical engineer of Paris and Versailles. In addition he was the first official hydrographic engineer attached to the French office of marine maps and plans. His *Mémoires sur les côtes de l'Amérique septentrionale* was published in Paris in 1775.

Differing from land surveyors, both in the nature and purpose of their work, were the military engineers of the French regime. These men, trained in surveying and mapping, arrived on the Quebec scene fairly early in the history of New France. Settlement involved the institution of defence measures against the raids of Indians and the onslaughts of hostile Europeans. Robert de Villeneuve, if not the first military engineer to arrive in Canada, undoubtedly was one of the best-known of these pioneering professionals. Nothing much is known of the date or circumstances of his birth and early upbringing. We know that he came to Canada as an Engineer of the King in the summer of 1685. It will be recalled that in 1688 Franquelin, Royal Hydrographer, while in France pressed Paris authorities for the same rate of pay "as the engineers (now) in Canada". This reference has been interpreted by historians to indicate the presence in New France, at that time, of Jean Deshayes and Robert de Villeneuve.

Governor de Denonville at Quebec, for reasons already examined, received de Villeneuve and Deshayes with a coolness that must have seemed to them a chill foretaste of Canadian winters to come. On May 8, 1686, the Governor wrote to Marine Minister Seignelay in Paris: "J'ai dessein d'envoyer à Niagara cette année le sieur Dorvilliers avec le sieur de Villeneuve, dessineur [sic] que vous m'avez donné afin d'en lever le plan, et après que j'aurai vu les Iroquis à Villemarie, en l'isle de Montréal, et que nous saurons a quoi nous en tenir avec eux, je verrai ai je ne pourai point moi-même y aller faire un tour pour pouvoir vous en rendre compte plus sûrement, car pour s'en fier au sieur de Villeneuve, seul, il est très bon, très sûr et très fidèle dessineur, mais pour le reste il n'a pas l'esprit assez arrangé, et l'a trop court pour pouvoir donner aucunes vues pour l'éstablissement d'un post, et pour en avoir la conduite de son chef".[2]

"I intend to send to Niagara this year sieur Dorvilliers with sieur de Villeneuve, a mapper you have sent me, who should make a survey of this place; after my meeting with the Iroquois at Villemarie on the island of Montreal and definite arrangements with them, I will consider whether I can go there and see for myself in order to give you a definite report because it is risky to have implicit confidence in sieur de Villeneuve alone; he is in some way deranged and is of such limited understanding that he could not give any mature observations upon the founding of a post and assume leadership of it".

In a report to the minister from de Denonville the latter states, "De Villeneuve has sent to you two maps he has made of the vicinity of Quebec and of the Isle of Orleans. I would have wished very much that he would have done also those of Ville-Marie, Isles des Prairies and the seigniory of Chesnaye and the remainder of this region of the colony but he made only sketches, having had no time to make neat copies. However, it would have been important for you to have had these this year in order that you could better see the need for sending troops to occupy the outposts at those places in order to defend the country.[3]

It did not take long for de Villeneuve to become embroiled in trouble in his new surroundings. Soon he was making a variety of charges against Prévost, the commandant at Quebec. By June 8, 1687, de Denonville could restrain himself no longer. He wrote to de Seignelay in regard to the accusations:

"Our engineer is a fool, a libertine and a pervert, all of which we endure because we need his services". The Governor warned the minister not to trust de Villeneuve and that the fellow might frequently write disparagingly of associates, creating charges entirely out of his imagination. The Governor also branded the engineer as a stooge but once the Governor's vocabulary of abuse was quite exhausted he had some good things to say about the man:

"Cependant il travaille admirablement bien de la main et forte vite quand il veut". (However, he works very well and very rapidly by hand when he wishes to do so.) The Governor indicates that M. de Vauban would likely testify to de Villeneuve's intelligence.[4]

Nine months after de Denonville's broadside, His Majesty, 'le Roy Soleil', ordered de Villeneuve to sail for France. The obedient engineer left sometime after June 27, 1688, returning to Canada in March, 1691. Intendant de Champigny accorded him a hearty reception at Quebec. . . . "ce refus procedait de ce que pendant cinq années précedentes que le dit sieur de Villeneuve avait demeuré au pays en qualité d'ingénieur par ordre de feu le marquis de Seignelay il s'était toujours oppose aux dépenses superflues qui s'y faissaient tant pour la construction de l'Intendance, qu'autres ouvrages que monsieur l'intendant faisant faire par des gens incapables. . . ."

"This non-acceptance originated in the fact that for the five preceding years the said Sieur de Villeneuve had spent in the country as an engineer in obedience to the Marquis de Seignelay he was constantly opposed to the unnecessary expenditures devoted to the construction of the Intendance as well as to other works built by inefficient people chosen by the Intendant".

As a result of his Canadian observations de Villeneuve completed a plan of the town and of the chateau of Quebec in 1685; a map of Quebec environs "mesurée sur le lieu Très exactment en 1685 et 1686"; also a map of St. Lawrence county, 1689, and a plan of Quebec and vicinity "under siege by the English, October, 1690". There is evidence that de Villeneuve also drew two maps of the Isle of Orleans.

In 1688, 1689 and 1690 de Villeneuve revised his 1685 plan of Quebec. His maps gave the names and surnames of citizens of the town and of surrounding parishes. Actually he drew many maps and plans and did not seem to suffer much from his less than exemplary personal reputation. Sieur de Villeneuve left Canada for the last time in 1693. It is probable that de Villeneuve was succeeded in his work by Hyacinthe B. de Beaucourt who made the plan for the construction of a redoubt on Cape Diamond as well as town gates and the old fortifications. In turn, de Beaucourt was replaced by Jacques Levasseur de Néré.

In the first half of the 18th century the most spectacular, if not the most memorable, surveying and mapping work carried on in Canada was that accomplished by the military engineers. In addition to the constant improvements made to the defences of Quebec the French decided, within the terms of the Treaty of Utrecht, to establish a heavily fortified point on Cape Breton Island, re-named by them Île Royale. In time the place selected came to be known as Louisbourg. The decision to fortify helped to bring into sharper focus the activities and achievements of the military engineers in New France.

In the negotiations leading up to the conclusion of the Treaty of 1713 the English at first took the stand that the French should not be allowed to fortify the island. But gradually this position in debate was relinquished. The French, for their part, were casting about with some concern for a place suitable for fortifications, a place so situated in a strategic sense as to guard effectively the seaward entrances to the Gulf and River St. Lawrence as well as the deep sea fisheries of the region. Such a port, ice-free and with some natural protection, could only be found at Havre à l'Anglois (English Harbor).

For a time Port Dauphin to the north on the island was a rival for the distinction of becoming the military, political and administrative capital but the existence of an extensive sandbar at the harbor entrance turned the scales in favor of Havre à l'Anglois which was also a more sheltered place. Under the Utrecht arrangements the French were compelled to leave Newfoundland while the English took over. Two years prior to the death of Louis XV in 1715 some 180 settlers were transferred from Placentia to English Harbor, soon re-named Louisbourg. Not until 1717, however, was the firm decision taken at Paris to erect military works of magnitude at this place.

The first qualified engineer to become associated with the Louisbourg military projects was Major l'Hermite, who was also a geographer. He had made at least two excellent sketches of Placentia while stationed there. When orders came from Paris to evacuate Newfoundland, he was transferred with Placentia's inhabitants to Île Royale. In the severe winter of 1713-14 l'Hermite worked to complete plans of proposed defences of the island and submitted his drawings to Governor Vaudreuil and Intendant Begon at Louisbourg in May, 1714. In June, 1715, l'Hermite was instructed to lay out works at Port Dauphin and also at Port Toulouse, to the south of Louisbourg. Again, in 1716, he made plans of fortifications at Louisbourg. The major was likely unaware that he had offended Paris authorities with what they considered excessively high estimates of fortification costs. At about this time an officer named Bourdon, unrelated so far as is known to the illustrious Jean Bourdon, arrived at Louisbourg in the vessel *Affri-*

cuain. He submitted a memoir on the location of the port and his map of Île Royale was in considerable use during this period. The advantages of Louisbourg were strongly underlined by Bourdon in his report, partly because of its relative freedom from winter ice and, in the spring months, from drift ice. On his return to Île Royale the unfortunate l'Hermite was again subjected to official criticism, this time for his slowness in making reports. He was finally stationed at Trois-Rivières. The major made yet another voyage to France but on his return in 1725 aboard the *Chameau*, lost his life in a shipwreck that occurred, ironically enough, not far from Louisbourg.

In the years 1700-1716 affairs declined to a wretched state on Île Royale owing to neglect and general incompetence on the part of home authorities. These were years of dire poverty, lack of commercial activity and isolation. The ill-clad peasantry suffered greatly during the severe winters of the region. Jean Maurice Beaucours had succeeded l'Hermite on Île Royale. He was not a qualified engineer but contrived to submit to superiors what were regarded by them as an engineer's reports. Like his predecessor in office Beaucours came under the disapproval of home authorities over what they considered to be inflated estimates of costs involved in building military works at Louisbourg. In time Beaucours was moved to Port Toulouse and ultimately to the colony in Quebec.

W. B. Munro in his *Documents Related to the Seigniorial Tenure in Canada* (p. 96) observes that Sieur de Catalogne, following his epochal survey of the seigniories of New France, had been sent to Louisbourg in 1717 where he was "put in charge of engineering work". On the face of it this statement seems to be opposed to reliable information that the Louisbourg fortifications, built by private contractors employing soldier labor, were designed and supervised by the military engineers, de Verville and Verrier.[5] The official records indicate that the plans made by the former, a superior type of engineer, as well as cost estimates and specifications for the fortifications were accepted at Paris and work began in earnest on the project on July 3, 1717. The de Verville plans called for completion of the fortifications within five years, at a cost of five million livres. There is a profile of the fort made by de Verville, dated 1722, at the Depôt des Fortifications des Colonies, Paris. A fair idea of the appearance of the town within its walls is obtainable from a Verrier water color now on display at the Fort Louisbourg Museum.

De Verville left for France in 1722 and in the following year his place was taken by Verrier, a prolific producer of maps, sketches and plans during the twenty years to follow. In 1730 he made a drawing of the town from the harbor side. More than a score of his mapping works are available today in various collections. The structures within the fortress were imposing compared to buildings then to be found in any of the English colonies. The disparity was eloquent of the differences in attitude and method of the two peoples. The French authorities evidently felt that the large size of the colonial structures at Louisbourg were suitable under all the circumstances, if somewhat expensive. Life at times must have been rather dreary for the inhabitants of the town, though there were periods of excitement. About 150 vessels called during a sailing season. The weather was variable. In the late autumn the drab earth had its counterparts in leaden skies and seas. In winter months the ground was usually deep in snow and the sea was sombre. The uninspiring prospect combined with general torpor resulting from chronic malnutrition rendered the cold months well-nigh unbearable. In the early springtime the waters outside the harbor glistened with drift ice. When the equinoctial gales ceased and calmer weather returned, Louisbourg was often afflicted by heavy fogs. But in the late spring and summer when the air was clear, when the waves sparkled in the warm sunshine and the surf tossed high against rocky shores, the picturesque coast was at its most attractive and life in that part of the New World seemed very good indeed.

Pierre-Jerome Lartigue, the King's storekeeper at Louisbourg and a member of a local family of prominence, regarded himself as a good engineer of amateur standing. He displayed a certain amount of engineering skill during the first siege of the fortress in 1745. In a subsequent civil suit Verrier testified to this fact. Lartigue, like all members of the family, was adept at making maps. It is said that the Lartigues left their lawyers loaded with maps of their possessions in connection with their last wills and testaments. In any event Pierre-Jerome has left us a memento of the 1745 siege in the form of an admirable map of Louisbourg.

In March, 1744, after 31 years of peace, France declared war on England. The appearance of French privateers off New England shocked the English colonists into dynamic action. Under Governor William Shirley of Massachusetts plans were developed for an armed expedition against Louisbourg, the base of French naval operations. William Pepperrell, a Maine merchant and militia officer, was given command of the attacking land forces. Commodore Peter Warren was placed in charge of the naval contribution. On March 24, 1745, accompanied by some armed colonial ships, some 4,000 men sailed from Boston in 19 transport vessels.

On April 30, the armada arrived off Louisbourg and anchored in nearby Gabarus Bay. The morale of the French garrison had been affected by a serious mutiny among the men during the winter months. But in the face of an approaching enemy a fair degree of unity was attained among the fort's defenders. A successful landing of invaders was achieved at Flat Point and within a short time the Grand Battery was captured.

By June 17, after 46 days of siege, Louisbourg's garrison capitulated. The colonials had shown courage, dash and resourcefulness as well as a distinct fondness for rum and plundering. Losses among the English colonials were relatively light, not exceeding 150 from all causes. But subsequent months of occupation took a fearful toll of lives. In the meantime, however, the colonists celebrated this hour of triumph, the capture of a fortress considered by the world to be well-nigh impregnable, by a pick-up army of nondescript colonials!

Warren was made an admiral for his participation and Pepperrell a baronet. The two leaders spent the winter months at Louisbourg as joint administrators of the occupation. From fever, dysentery and scurvy some 890 New Englanders died before the spring of 1746. When in April, 1748, under the Treaty of Aix-la-Chapelle, Louisbourg was restored to France, the anger of the New England colonists knew no bounds. Their supreme effort to eliminate the French threat to their security, the terrible losses encountered while occupying Louisbourg, their bold capture of what had generally been regarded as a supremely important stronghold, all appeared to be lightly bargained away by remote negotiators engaged in some unfathomable diplomatic chess game. By July, 1749, at a time when a youthful George Washington was qualifying as a commissioned surveyor for Culpeper county in Virginia, the white and gold flag of France was being raised once again over the battlements of Louisbourg. But so far as North America was concerned the peace period was never more than a time of uneasy truce. Each side prepared, more or less openly, for a renewal of hostilities.

Acadia, until mid-18th century days, had suffered from the absence of accurate marine charts and topographical maps. A Lieut. Blackmore of H.M.S. *Dragon* unworthily assuming the role of a surveyor general, made a very rough and highly unreliable draft of the Acadian coastline about 1715, petitioning the Board of Trade and Plantations to permit him to survey the same. This survey, if authorized, was never carried out. But the draft, unfortunately, fell into the hands of a map publisher who printed and issued it as an actual survey. This type of inaccurate information led to protests, one of which is on record, ". . . In short, we do not find a single spot hardly justly laid down in these our New Maps of Nova Scotia. We are so far from improving them in the Geography of America that we see it made worse and worse for want of certain observations which we have endeavored to collect and thus represent in one view . . ."[6]

In this context the carefully conducted Acadian coastal and hydrographic surveys made in 1750-51 by Joseph Bernard M. le Marquis de Chabert are all the more noteworthy. His activities were designed to achieve a scientific revision of existing erroneous maps and charts. Sieur de Chabert, in fact, did produce some remarkably fine maps, some of them including information on soundings. Some of his maps and charts along with an excellent account of this survey project are contained in a volume entitled: "*Voyage fait par ordre du roi en 1750 et 1751 dans l'Amérique Septentrionale pour rectifier les cartes des côtes de l'Acadie, de l'Isle Royale et de l'Isle de Terre-neuve*".*[7]

In the text of a certificate reproduced from the records of the Royal Academy of Sciences of France the main purposes of the Chabert project are outlined: ". . . il etoit nécessaire pour la perfection de la Géographie et la sûreté de la Navigation, d'avoir des observations de longitude sur les côtes qui sont à l'orient de Boston et dont la position étoit absolument incertaine; donne le résultant des observations qu'il a faites en divers endroits de ce continent et principalement à Louisbourg, auxquelles il a joint les opérations de Geométrie-pratique qu'il a été obligé d'employer pour découvrir les vrais contours de ces côtes, dont il a dressé une nouvelle carte, en se servant aussi quelquefois des moyens que fournit l'Hydrographie, lesquels étoient seuls pratiquables, lorsqu'il s'agissoit de fixer la situation des Isles et des Caps . . . .".

In the narrative of the book M. de Chabert points out, "J'avois principalement à fixer avec exactitude la longitude de Louisbourg, soit pour en faciliter l'abord aux Vaisseaux qui viennent dans ce port, soit afin que dans la construction des cartes on pût partir de ce point pour placer tous les autres des côtes de cette partie de l'Amérique septentrionale dans leurs véritables méridiens, ce qui dépendoit de la juste détermination de celui-ci".

In a further passage M. de Chabert describes his method of surveying: "Je commencai à prendre des hauteurs correspondantes du Soleil, et je répétai la même opération tous les jours de temps clair, pour me bien assurer de la marche de la pendule et me trouver toûjours en état de savoir l'heure à chaque observation que j'aurois faite: l'assiduité de ce soin, souvient superflue dans tout autre pays, et très-pénible dans celui-ci, étoit cependant indispensable, parce que le froid excessif arrêtoit souvent la pendule, quoique son mouvement fût d'ailleurs bon et uniforme".

". . . Improved geography and secure navigation required that observations for longitude [be] made on the coasts situated east of Boston and whose locations were completely uncertain . . . reported results of observations made in some places on this continent, mainly at Louisbourg, to which he annexed the processes of practical geometry he used, in order to draw the exact coastline of these regions of which he drew a new map, using sometimes as well hydrographic data applicable when places to be located were islands and capes . . ."

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*"Trip made by order of the king in 1750 and 1751 in Northern America in order to rectify the Maps of the Coasts of Acadia, of Isle Royale and of Newfoundland."

"I had in the main, to determine with accuracy the longitude of Louisbourg either to make the approach to it easy for vessels entering this harbor, or in map making to use it as a starting point to fix all the other points of the coast in this region of North America in their true meridians, all of which depended on the right position of that place [Louisbourg] . . ."

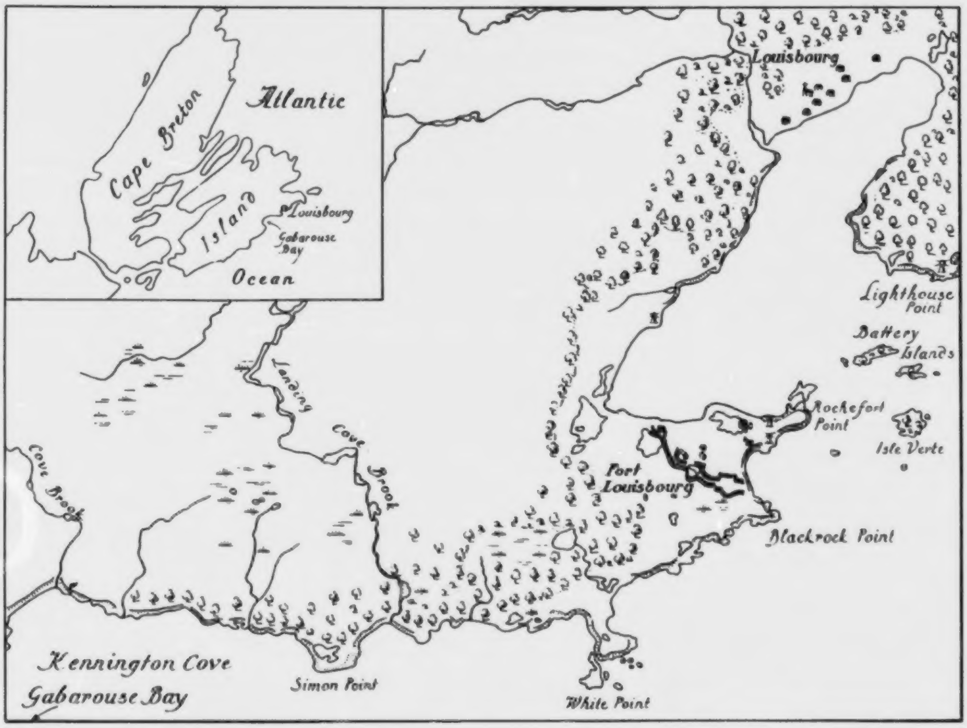
"I began to note corresponding heights of the Sun and I repeated the operation each clear day in order to make sure of the movement of the clock and to be able to recognize the right hour of each observation we would make; this constant care, often useless in any other country and very difficult in this one, was nevertheless essential because the cold, rigorous weather often stopped the clock though otherwise its movements were good and unvarying".

At about this same period a Virginia physician and botanist began working on a map of North America. So far as is now known this was the only map he ever made but it proved to be a masterpiece of 18th century cartography. John Mitchell was not only a doctor, he was an authority in his time on yellow fever. But his name is perpetuated not because of any botanical or medical achievements but for the famous Mitchell map. There is evidence that the map was first drawn in 1750 but over a period of five years it was revised and improved before delivery to the printers. The map is dated 1755. During the following 20 years it was published in at least 3 editions. The foundation of the map consists of several manuscript maps, also charts and surveys made in the colonies and it portrayed most of the principal places between the Atlantic and Mississippi.

The Mitchell map provides a fair representation of the courses of the St. Lawrence, Ohio and Mississippi Rivers as well as of the Great Lakes shoreline and includes relative distances between settlements of the North American interior. The map was a highly useful part of the standard equipment of British officers during military campaigns preceding the formation of the United States. It became a much consulted reference work in the possession of international commissions deliberating over Canada-United States boundary lines. The map was assembled under the direction and authority of the British Board of Trade and Plantations. "This map was undertaken," states a communication over the signature of the Board Secretary, John Pownal, himself a surveyor, "with the approbation and at the request of the Lords Commissioners for Trade and Plantations — and is chiefly composed from draughts, charts and actual surveys of different parts of His Majesty's Colonies and Plantations in America . . ." The title box or map legend contains the following statement: "A map of the British Colonies in North America with the Roads, Distances, Limits and Extent of the Settlements, humbly inscribed to the Rt. Hon. the Earl of Halifax and the other Right Honourable the Lords Commissioners for Trade and Plantations . . Jn. Mitchell".

In the age in which it was made, Mitchell's map was a first-class cartographical production although more extensive geographical knowledge was actually available at that time than Mitchell was able to obtain. His collation of details relating to eastern North America, and especially to the seaboard colonies is most commendable but knowledge of the vast Canadian West apparently was so scanty that the map extends to just west of the Lake of the Woods and to just north of the Albany River system. It was drawn to a scale of about 43 miles to the inch.

By 1755, as Mitchell was completing his great map, squadrons of French men-of-war under Du Blois de la Motte arrived to strengthen the defences of Louisbourg. This new leader had been instructed to secure Louisbourg from attack. He used sailors and soldiers alike to construct earthworks at all coves in the vicinity of the fortress. A map


Atlantic
Cape Breton
Island
Louisbourg
Gabarouse Bay
Ocean
Louisbourg
Lighthouse Point
Battery Islands
Rochefort Point
Isle Verte
Fort Louisbourg
Blackrock Point
Landing Cove Brook
Cove Brook
Kennington Cove
Gabarouse Bay
Simon Point
White Point

MAP 22. Louisbourg Harbor and vicinity c. 1717. Reconstructed sketch, courtesy of Department of Mines and Technical Surveys, Ottawa.

by de la Motte is still in existence and it shows the extent of the new protective works. On May 18, 1756, England declared war on France, and that country returned the compliment on June 9th. By the spring of 1757 William Pitt had reached the summit of British affairs as well as full control of the nation's renewed military effort, by virtue of his special genius for leadership and organizaton. Not only did a contagious spirit of confidence permeate the whole of the armed forces, a new sense of direction prevailed throughout the realm. A great new campaign was launched to reduce Fort Louisbourg, the capture of which meant acquiring the key to the very gates of Canada, the St. Lawrence entryway.

In the spring of 1758 a fleet of 23 ships under Admiral Boscawen brought troops to Halifax, commanded by Major-General Amherst and his three brigadiers, Whitmore, Lawrence and the 31-year old James Wolfe. By June 2, a total of 108 English ships carrying 1,842 cannon and immense quantities of war supplies brought 13,142 officers and men of the land forces to Gabarus Bay. In this rather formidable expeditionary force were two newly-appointed, relatively obscure young lieutenants. But these officers were destined during the approaching action not only to establish reputations of some military significance but also to launch lifetime careers in mapping as well as in land and marine surveying. Both Samuel Jan Holland(t) and Joseph Frédéric des Barres were

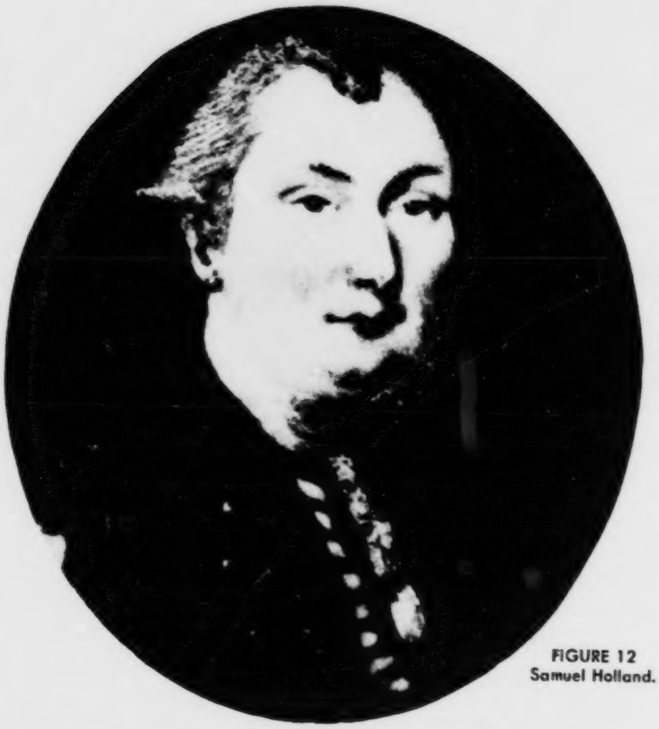


FIGURE 12
Samuel Holland.

lieutenants in the 60th Regiment of Foot, the Royal Americans. Both were European-born, talented engineers and gifted in the arts of map making and sketching. Both young men proved their bravery and resourcefulness under fire. In America their names became Anglicized to Holland and to DesBarres.

Samuel Jan Hollandt was born near Nijmegen, Holland (not far from the frontier with Germany) in 1728. At the age of 17 he joined the Dutch army at a time when Holland was being invaded by the French. He was in active service for about three years, including participation in the siege of Hulst in 1747 when the French were repulsed. He became a lieutenant in the Dutch artillery. In 1754 he parted company with his wife, the former Gertrude Hasse, after five years of marriage. They were childless and the separation, so far as is known, was amicable. The 26-year-old officer proceeded to England, never to return to the continent. In time he dropped the letter "t" from his surname although the original spelling persists in British military records throughout his army service.

From the outset Samuel Holland seems to have had easy and effective access to highly placed and influential persons in England. Soon after his arrival in London the Duke of Richmond befriended him and obtained for him a lieutenancy in the 60th Regiment of Foot. Officers of the Royal Americans, as this unit was called, were being recruited for service in the New World. Soon after Holland's appointment he was introduced to Lord Loudon by whom he was employed for a time as a map draftsman. This was only four years prior to the second siege of Louisbourg, a fateful turning point in

Holland's life. When Lord Loudon came to America in July, 1756, to take over the chief military command from Governor William Shirley of Massachusetts, Lieut. Holland accompanied him.

Fortune seemed to smile happily on Holland at every turn of his career. He had special gifts, quite apart from inborn diplomacy and an unusual facility for making true friends in high places. He was an excellent draftsman, well-trained in military engineering, familiar with several languages and he possessed some years of army service in the field. He never avoided a hard challenge or dangerous adventure and was, above all, intensely ambitious.

Not long after his arrival in North America, Holland won recognition of his abilities and quickly rose in rank. On May 21, 1757, he was made a captain-lieutenant.[8] He never experienced much difficulty in impressing his superiors, whether on scouting missions or in the drawing of maps and plans. Holland was attached in due time to the command of Brigadier James Wolfe as an army engineer qualified to make surveys, to prepare maps and to take soundings of waters in the vicinity of Louisbourg for the purposes of the siege of that fortress. Wolfe was not any more immune than others from the aura of confidence and reliability that Holland managed to exude. The brigadier deferred to him in engineering matters, an attitude all the more impressive because of Wolfe's antipathy to engineers and engineering generally. At Louisbourg Holland was entrusted with the leadership of an initial attack on the northeast part of the harbor.

At Louisbourg, also, with the Royal Americans was the Swiss-born Joseph Frédéric des Barres, born in 1721. Like Holland he came to England early in his career and also like Holland won a commission in the 60th Regiment, attracted by the idea of going to North America. Unlike the young Dutchman he attended the Royal Military College at Woolwich in preparation for his overseas service. Hard on the heels of the staggering defeat suffered by General Braddock's British regulars in 1755, the high command in England decided upon a change in army tactics by recruiting men more knowledgeable in backwoods lore. Such men, mostly Americans, were to be enrolled in a regiment of four battalions of a thousand men each. In this connection Lieut. DesBarres was ordered, on his arrival in the New World, to raise recruits in Pennsylvania and Maryland. He managed to enrol more than 300.

In his native Switzerland DesBarres had been given a thorough grounding in the sciences. A highly trained sketcher, he possessed robust health and a superabundance of energy. He was capable of prolonged intensive effort and his courage was never in doubt. But, unlike Holland, he was frequently impetuous, intemperate in speech and action under stress. Where Holland made friends easily, DesBarres managed to stir deep antagonisms. His was a tempestuous life and promotions in military rank came to him slowly. In 1771, 13 years after Louisbourg, he was still a lieutenant!

When the British armada, under Boscawen and Amherst, arrived at Gabarus Bay on June 2, 1758, thirteen years had passed since the successful conclusion of the first siege of Louisbourg. Adverse weather, however, prevented any landing attempt until June 8th when Wolfe's men got ashore in Kennington Cove. DesBarres, with the second battalion of Royal Americans, was one of the first of the invading forces to land and he captured a French entrenchment on the first rush. Brigadier Wolfe was suitably impressed and saw that the Swiss-born lieutenant accompanied him as an engineer to the siege of Quebec the following year.

Although H.M.S. *Pembroke*, under the command of Capt. J. Simcoe, had arrived too late to take any part in the troop landings, the vessel did form part of the blockading fleet. Aboard, as 30-year-old sailing master of the ship, was James Cook. Born in a Yorkshire village in the same year as Samuel Holland (1728) James Cook was in every good sense a self-made man. Extreme poverty was his lot as a child but young Cook educated himself in mathematics, astronomy, navigation and cartography. He joined the Royal Navy in 1755 at the age of 27, serving H.M.S. *Eagle* and H.M.S. *Solebay* until he joined the *Pembroke,* one of Admiral Boscawen's ships of the line, in October, 1757. On that stormy and prolonged voyage across the Atlantic the following year he had seen 29 crewmen of the *Pembroke* die from disease.

The second siege of Louisbourg lasted about as long as the first. The French defenders, about 6,000 in all, fought gallantly against very considerable odds. The English naval blockade resulted in rapidly dwindling ammunition within the fortress, and English batteries pounded the town and fortifications mercilessly. On one day alone a single English battery of six guns fired 600 cannon balls at their targets. At one stage of the siege the French tried, without success, to block the harbor entrance by sinking five of their ships at its entrance. On Lartigue's map the topmasts of these sunken vessels show above the surface of the water.

On July 27th, following a day-long discussion of capitulation terms, British troops marched into the battered fortress through the Dauphin Gate. French losses in personnel killed in the siege amounted to 411, the British, 195. Boscawen and Amherst decided it was too late in the season to proceed against Quebec. The courageous defenders of Louisbourg had managed to purchase some precious time—they saved Canada for a year for the French empire. A decision was made at the highest levels in England, after much deliberation, to demolish Louisbourg's defences and by October, 1760, the extensive demolition work had been completed.

In a letter written 34 years after these momentous events, Samuel Holland, who had become Surveyor General of Canada, relates to John Graves Simcoe, first lieutenant-governor of Upper Canada, how he first met the governor's father, then captain of H.M.S. *Pembroke*:

"The day after the surrender of Louisbourg, being at Kennington Cove, surveying and making a plan of the place . . . I observed Captain Cook (then sailing master of H.M.S. *Pembroke*) particularly attentive to my operations and as he expressed an ardent desire to be instructed in the use of the plane table (the instrument I was using) I appointed the next day in order to make him better acquainted with the whole process—he accordingly attended with a particular message from Captain Simcoe expressive of a wish to have been present at our proceedings and his inability, owing to indisposition of leaving his ship—at the same time requesting me to dine with him on board, and begging me to bring the Plane Table pieces along . . . I remained that night on board, in the morning landed to continue my survey at White Point, attended by Captain Cook and two others whom your father wished should be instructed in the business . . . During our stay in Halifax, whenever I could get a moment of time from my duty, I was on board the *Pembroke* where the great cabin, dedicated to scientific purposes and mostly taken up with a drawing table, furnished no room for idlers. Under Captain Simcoe's eyes Mr. Cook and myself compiled materials for a chart of the Gulf and River St. Lawrence . . . Another chart of the River, including Chaleur and Gaspé Bays . . . was compiled and drawn under your father's inspection, and sent by him for immediate publication to Mr. Thos. Jeffrey, predecessor to Mr. Faden. These charts were of much use, as some copies came out prior to our sailing from Halifax to Quebec, 1759.

"By the drawing of these plans under so able an instructor, Mr. Cook could not fail to improve and thoroughly brought in his hand as well in drawing as protracting, etc. and by your father's finding the latitudes and longitudes along the coast of America, principally Newfoundland and the Gulf of St. Lawrence, so erroneously heretofore laid down, he was convinced of the propriety of making accurate surveys of those parts.

"In the necessity of having surveys of these parts and astronomical observations made as soon as peace was restored, he would recommend him to make himself competent to the business by learning Spherical Trigonometry with the practical part of Astronomy, at the same time giving him Leadbitter's works, a great authority on astronomy . . . Mr. Cook fulfilled the expectations entertained of him by your father —in his survey of Newfoundland.

"Mr. Cook in London in 1776, after his several discoveries, confessed most candidly that the several improvements and instructions he had received on board the *Pembroke* had been the *sole foundation* of the services he had been enabled to perform . . ." (author's italics). Samuel Holland then closes the letter with regretful references to his lost journals, which he claimed had been stolen from him in a London bus.[9]

Captain-Lieutenant Holland continued his surveys in the vicinity of Louisbourg until the end of the 1758 season. He then proceeded to Halifax and was employed there on the plotting of his summer's surveys and in drawing up plans. Lieut. DesBarres, after the fall of Louisbourg, obtained from French officers a number of documents and plans concerning the Gulf and River St. Lawrence. During the following winter months in Halifax he prepared a large-scale chart of the river that was of great service to the British fleet on its expedition against Quebec. As indicated in Holland's letter of 1792, James Cook was also in Halifax during that winter and there is evidence that he was instructed by DesBarres in mathematics, astronomy and surveying.

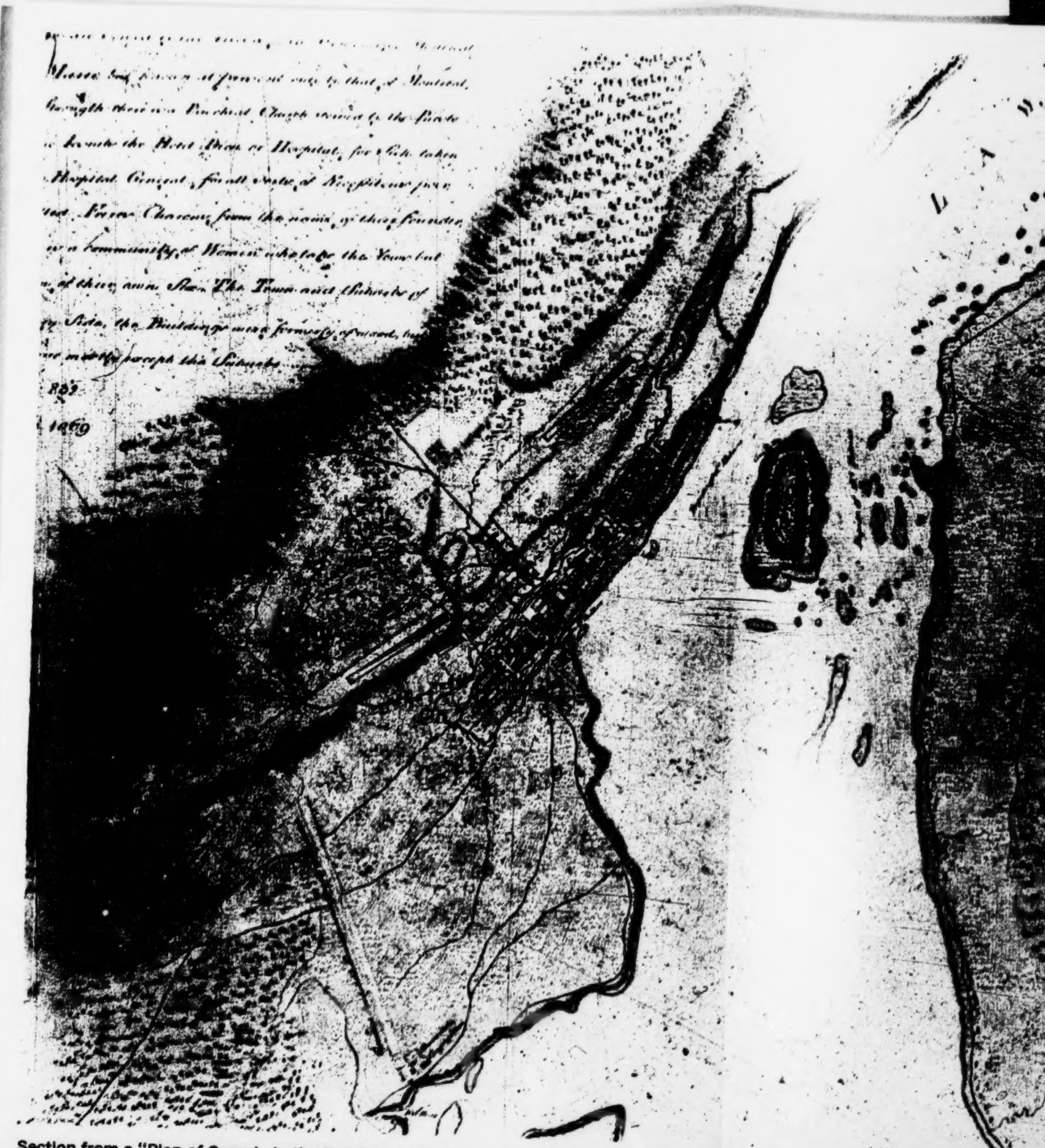
11

NOTABLE PIONEER SURVEYORS OF BRITISH NORTH AMERICA

The capitulation of Louisbourg in 1758 was, to an important extent, due to the lack of sufficient French naval strength in the Atlantic. Sea power superiority over any rival nation was indispensable to any successful defence of the Île Royale fortress. But it was England, not France, that exercised effective control of the high seas at the end of the first half of the 18th century. As a French poet perceived it, "Le trident de Neptune c'est le sceptre du monde" (Neptune's trident is the symbol of world power). For the nation possessing the vital naval advantage, Louisbourg's fall awaited only upon a favorable opportunity linked with resolute action. William Pitt saw to it that the action was taken. Now with Louisbourg in ruins, Quebec's reduction was largely a matter of time, assuming the existence of the required determination combined with inspired military and naval leadership on the part of the attackers. Canada's survival as a French colony was more than ever dependent upon the active goodwill of its remote overseas authorities. For the colonists it was a situation fraught with the gravest dangers.

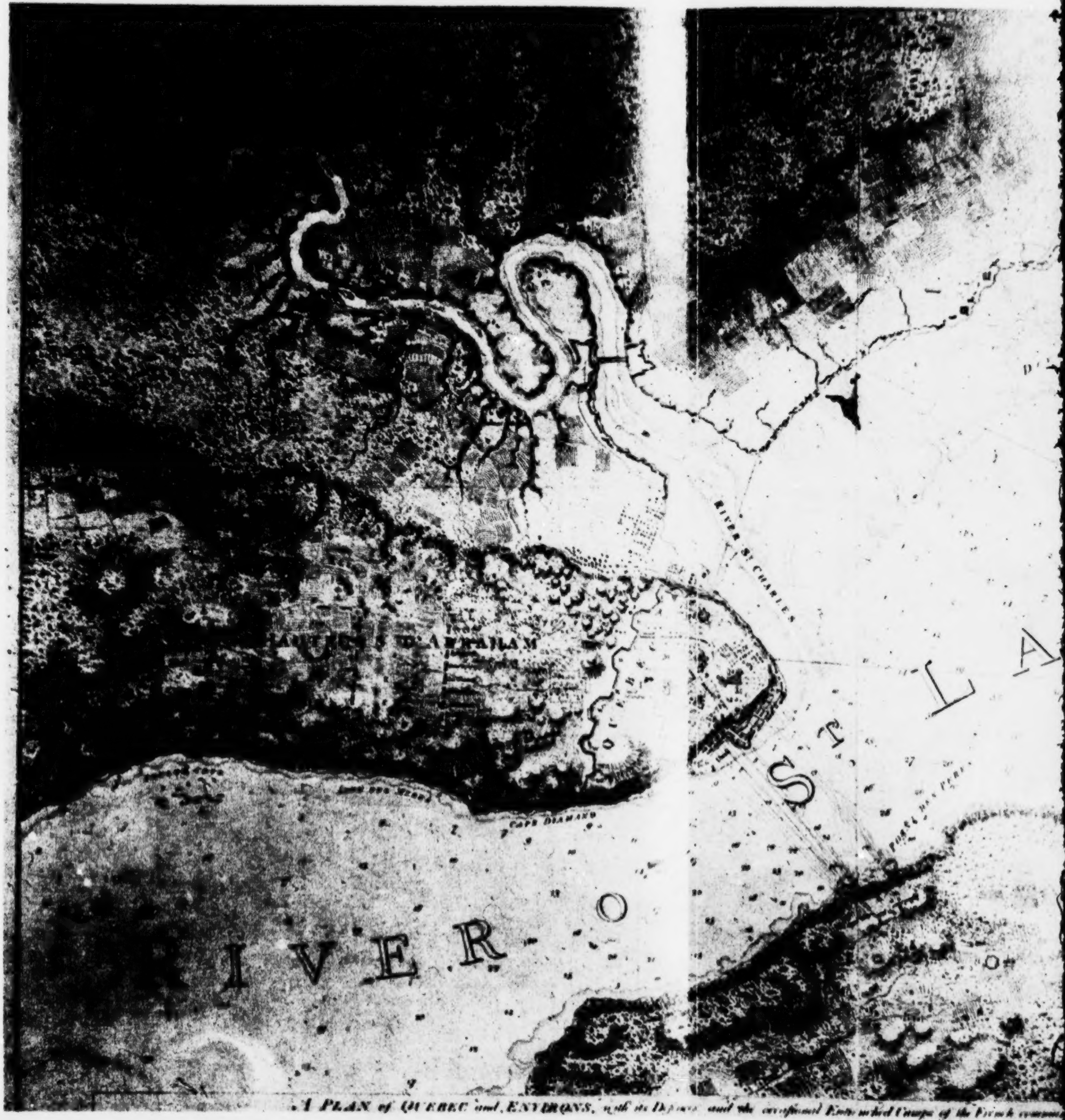
What had been up until the late spring of 1759 only a distant, if undiminished, threat to the settlers of New France, now developed into a real and readily seen menace. English warships moved out of Halifax harbor following the long winter months of relative inaction and sailed for the entrance of the St. Lawrence River. By June 21 the attacking fleet consisted of 145 vessels. About this time the first important encounter between the French and British on the river took place near the Isle of Orleans. The *Pembroke* had sailed with the fleet but Capt. John Simcoe did not live to see Quebec. He died en route from Halifax and was buried at sea. Continuing on her voyage the *Pembroke* was destined to perform an active and gallant part in the siege.

James Wolfe at Quebec, as at Louisbourg, benefitted from the services of engineers

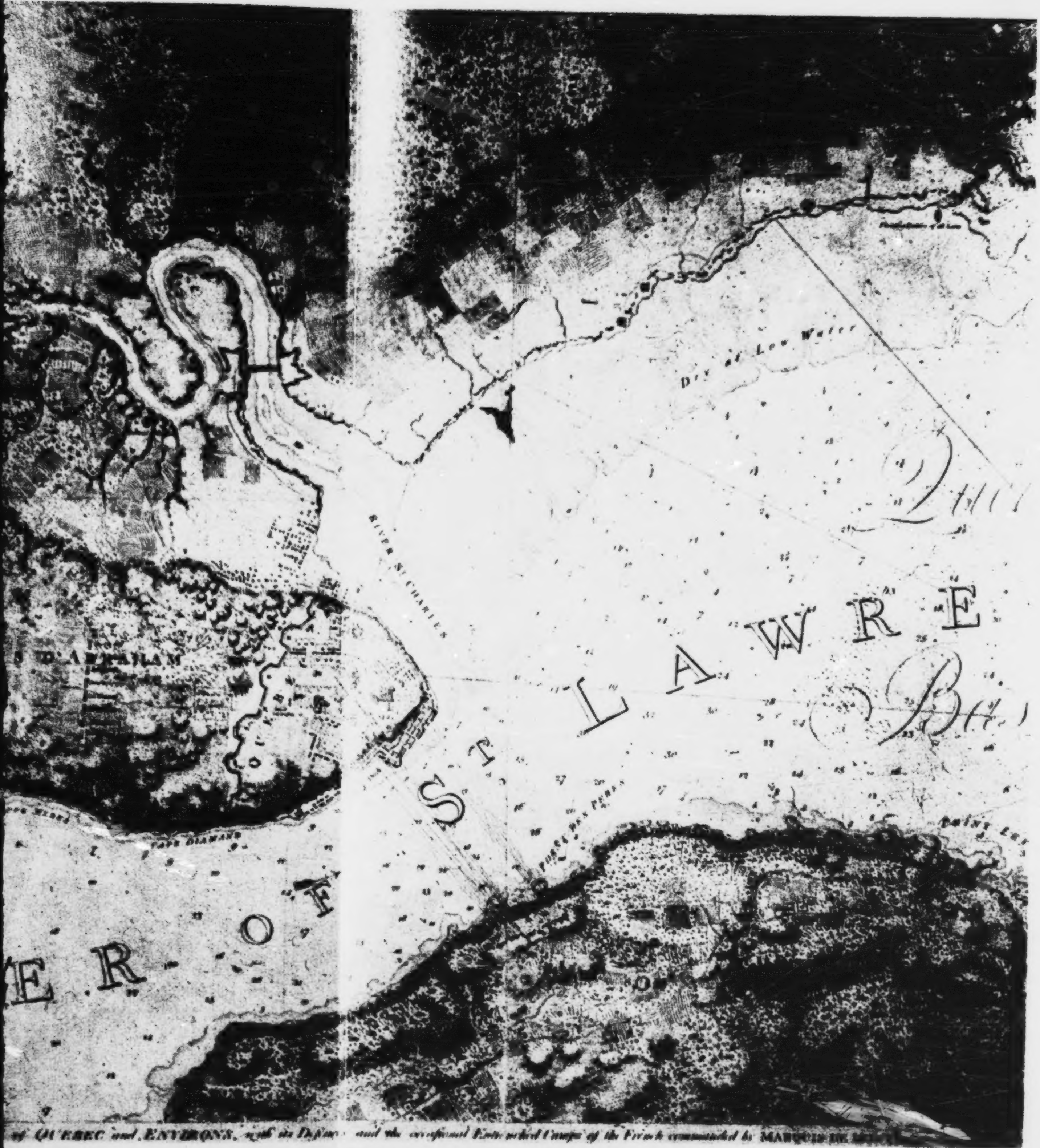

Houses being known at present only to that of Montreal.
though there is a Parochial Church owned by the Priests
besides the Hotel Dieu or Hospital, for Sick taken
Hospital General, for all sorts of Necessitous persons
Sœurs Charons from the name of their founder
are a Community of Women who take the Vows but
of their own Sex The Town and Suburbs of
Side, the Buildings were formerly of wood, but
except the Suburbs
1869

Section from a "Plan of Canada in the Province of Quebec. . surveyed by order of his Excellency, Governor Murray in the years 17

ebec. . surveyed by order of his Excellency, Governor Murray in the years 1760-62". Courtesy of the Public Archives of Canada.


RIVER St CHARLES
CAPE DIAMOND
I V E R O
S T L A
A PLAN of QUEBEC and ENVIRONS, with its Defences and the occasional Entrenched Camps of the French comm

"A plan of Quebec and Environs with its Defences, during the Siege of that place in 1759." Surveys made by Lieut-Colonel Debbieg, Major Samuel Holland and Captain DesB



of QUEBEC and ENVIRONS, with its Defences and the occasional Entrenched Camps of the French commanded by MARQUIS DE MONTCALM
RIVER ST CHARLES
Dry at Low Water
ER OF ST. LAWRE
S D'ABRAHAM
CAPE DIAMOND
POINT DES PERES
POINT LEVI

Siege of that place in 1759." Surveys made by Lieut-Colonel Debbieg, Major Samuel Holland and Captain DesBarres. Courtesy of the Public Archives of Canada.

and surveyors, notably Major Patrick Mackellar, Major Samuel Holland and Lieut. Joseph DesBarres. Mackellar, who had been a prisoner of the French at Quebec in previous months, compiled a detailed plan of its defences. In accuracy and completeness, however, this plan left something to be desired. Holland, as might be surmised, seemed to be the most solidly installed of these three men in Wolfe's esteem and affections. He was promoted, on Wolfe's recommendation, to the rank of full captain on August 24, 1759, just a few weeks before the Battle of the Plains of Abraham.[1] In addition to the timely promotion Holland received from General Wolfe a brace of duelling pistols suitably inscribed. The pistols were to play a gruesome part in a tragedy that marred Samuel Holland's later years.[2]

Holland was less than convinced, as he grew older, that his very active and prominent part in the 1759 siege of Quebec had been properly recognized. Writing to a friend 25 years after the events of that fateful summer, he complained, "In the battle of September 13 (Plains of Abraham) your memorialist lost his protector (Wolfe) while holding his wounded hand at the time he expired . . . for reasons best known to Mr. West, the painter, your memorialist was not admitted amongst the group represented but others are exhibited in that painting who never were in the battle".

After the battle Capt. Holland laid out the meridian line and established stone monuments in the vicinity of the spot where Wolfe fell. Even with the death of his distinguished benefactor Holland's special abilities continued to win favorable attention from his superiors. In the action at Ste. Foy late in April, 1760, when Lévy soundly defeated Murray and pushed the British troops back behind the walls of the town of Quebec, Patrick Mackellar was wounded and it was Capt. Holland who was appointed by Brigadier General James Murray as Acting Chief Engineer of the garrison. But Holland was never fully accepted by the military professionals in that capacity. After all he never belonged to the Royal Engineers as did Major Mackellar.

It was about this time in the history of England that George III began to make most remarkable use of the special opportunities he enjoyed to collect maps of both a topical and permanent value. In his royal collection he made topography and North American geography conspicuous. Maps were gathered for him from military and civilian surveys as well as in the form of charts that were the work of official hydrographers. The collection is now a highly prized part of the contents of the British Museum. The "George the Third Map", as it is known (and probably the most celebrated item of the royal collection), is a 3rd edition of the Mitchell map of 1775. The monarch, despite his contribution to the permanent loss of the American colonies, helpfully intervened some 12 years after the fall of New France to make certain that John Harrison received his richly deserved cash reward for solving the problem of finding longitude accurately at sea. In addition George III took a very active interest in surveying projects in England leading up to the establishment of the Ordnance Survey in that country.

In 1760, 1761 and 1762 Capt. Holland was employed by General Murray in surveying the settled parts of what had formerly been known as New France. In a report to home authorities dated June 5, 1762, General Murray wrote, "I ordered Captain Holland to make an accurate survey of the ground and I have the honour herewith to transmit the several plans he has drawn in consequence . . . He is an industrious, brave officer and an intelligent Engineer, in which capacity he would be desirous, and deservedly merits, to be advanced . . ."

In the Public Archives of Canada, Map Division, there is a "Plan of Canada or the Province of Quebec from the uppermost settlements of the Island of Coudre as Surveyed by Order of His Excellency, Governor Murray, in 1760, 1761 and 1762 by the following gentlemen:

Captain Holland, Captain Spry, Lt. Montrefors, Lt. Peach, Lt. Fuzer, Lt. Haldimand and Ensign Pittman. Captain Holland was assigned the area from Montreal to St. Therese Island on the north side of the St. Lawrence River; on the south side of the river from Longueuil to Becancour, parts of Rivers Sorrel [sic], Yamaska, St. François and Nicolet with the Islands in that extent; also from St. Augustin to Quebec, Rivers of Cape Rouge and St. Charles with all the back settlements to the River of Montmorency on the north side; also the town of Three Rivers and River St. Maurice. Captain Spry was assigned the Isle of Orleans; Lt. Montrefors, from Montreal to LaChine and the island St. Paul from Repentigny to Berthier on the north side. Lt. Fuzer had the remainder of the Island of Montreal, also the Lake of Two Mountains and the "coast" of Vaudreuil; Lt. Haldimand, who later was to play an important part in Holland's maritime provinces' surveys, was assigned to the area from the Chaudiere River to the uppermost settlements of Satigan—from St. Joachim to Les Eboulements on the north side . . ."

In the reports of these surveyors it is interesting to find such revealing observations as "Quebec when it fell into the hands of the English on the 18th September was in a most ruinous condition, there being hardly a house in Town that was not hurt either by Shot or Shell or was habitable without repairing . . ." and, again, "The fortifications which consisted of little more than the fronts towards the land were not much above half finished, there being neither Ditch covered nor Outworks, the Scarp Wall was seen in many Places from the Top of the Parapet to the Foundation notwithstanding these and a variety of other Difficulties, it was resolved to keep possession of it — and all possible measures for the Security and Accommodation of the Garrison were entered upon without delay . . ."

The maps resulting from these surveys, for detail, were the best produced in Canada in that period. The Murray Atlas, in fact, represents probably the most elaborate topographical survey and mapping project to be found anywhere within the British Empire up to that time. Beautifully drawn, these maps were mounted on 44 linen sheets. The exacting work that filled these postwar days did not, however, abolish all opportunities to show gallantry towards fair ones among the new subjects of the British Crown. During the years immediately following the transfer of Canada from French to British rule, officers in Major-General Murray's army fraternized with the best French Canadian families at Quebec. Partly because Capt. Holland spoke French fluently he made a somewhat more favorable impression on les Canadiens than did most of his military colleagues. In any event he completely won the heart of a woman of remarkable beauty, the youngest daughter of François Rolette and Thérèse Grenet, namely, Marie Josephte Rolette (dit Maure). The father was adamant in refusing to permit his daughter to marry one of Wolfe's army and the couple found it necessary to elope. No record of the marriage ceremony has been found but the next best evidence available points to the conclusion that this 1762 wedding took place aboard a ship in Quebec harbor. Incidentally, Thérèse Grenet's son by a previous marriage, namely, Jean Baptiste Bouchette became the father of Joseph Bouchette, who, in time, succeeded Holland as Surveyor General of Lower Canada.

In February, 1763 the great Peace of Paris was signed and Canada was ceded to Great Britain. In fact, all of the French possessions in North America with the exception of Louisiana now became part of a British empire in the New World, extending from Florida to Labrador. The province of Quebec was created and its western boundary was to run north-west to Lake Nipissing from the point at which the 45th parallel of latitude crossed the St. Lawrence River. The boundaries of Nova Scotia were extended. The first census in New France under the British revealed a population of 60,000. Brigadier General Murray was appointed the first British civil governor of the province of Quebec, the first of three military men to occupy that post. It was in this crucial year that Augustus Jones was born, a man destined to play a most influential part in the surveying of Upper Canada. And it was on December 7, 1763 that Governor Murray received Royal Instructions in regard to Land Grants in Canada.[3] These particular orders were part of more general instructions and are contained in paragraphs 41-59 inclusive and based upon the terms of the Peace Treaty. Some extracts are significant:

"You are, therefore, as soon as conveniently may be [to] cause an *accurate survey* to be made of the said province . . . you are therefore to lay out townships of a convenient size and extent in such places as you in your discretion shall judge most proper. And it is our [Royal] will and pleasure that each township do consist of about 20,000 acres having, as far as may be, natural boundaries extending into the country and comprehending a necessary part of the river St. Lawrence when it can be conveniently had . . . reserving proper quantities of land in each township for the following purposes: for erecting fortifications and barracks where necessary or for other military and naval services, and more particularly for the growth and production of naval timbers . . . a spot in or near each town set apart for the building of a church and 400 acres adjacent . . . for maintenance of a minister and 200 [acres] for a schoolteacher.

"And you are to give strict orders to the surveyors whom you shall employ to mark out said townships and towns, to make returns to you of their surveys as soon as possible, with a particular description of each township and the nature of the soil within the same. [It was from the institution of this good habit that the surveyors of the western prairies more than a century later produced such a wealth of informative and comprehensive reports.]

"And you are to oblige all such persons as shall be appointed to be surveyors of the said lands in each township to take an oath for the due performance of their offices and for obliging them to make exact surveys of all lands required to be set out.

"And whereas nothing can more effectively tend to the speedy settling [of] our said colony, *the security of the property of our subjects* and the advancement of our revenue, than the disposing of lands upon reasonable terms, therefore (conditional upon satisfactory qualifications being shown by the applicants) you are to *cause a warrant to be drawn up directed to the Surveyor General* empowering him . . . to make a faithful and exact survey of the lands, petitioned for, and to return the said warrant within six months . . . with a plot or description of the lands so surveyed thereunto annexed. (author's italics)

"In all surveys the surveyor [should] be required to take particular notice . . . how much of the land surveyed is plantable, and how much of it is barren and unfit for cultivation, and accordingly to insert in the survey and plot by him to be returned to the registrar's office, the true quantity of each kind of land . . ." Also, the surveyors were required to report upon what lands were considered by them fit for the production of hemp and flax and what land ought to be reserved for the cutting of timber to supply masts for the British Navy.

These 1763 instructions contain features of what was, in essence, the first land-use plan to be applied in Canada. These orders to the Governor also served to emphasize the indispensable partnership of surveying and mapping in relation to the development of Canada's natural resources and, in particular, to its resources of agricultural land. The need for strong personal leadership in this area of activity had become urgent. Capt.

Holland's experience and special competence, his marked ability to get along with his superiors, again stood him in good stead at this critical time for the country and for himself. He had not been idle in England. In 1762 he had submitted a plan to the Lords Commissioners of Trade and Plantations urging the launching of a scientific survey of British possessions in North America as a means of facilitating land settlement.

On February 4, 1764 a memorial, signed by four Lords of the realm, was submitted to His Majesty King George III: "We, your Majesty's Commissioners of Trade and Plantations humbly represent to your Majesty that, in consideration of measures proper for the dividing, laying out and settling such parts of . . . American dominions . . . we find ourselves under the greatest difficulties arising from *the want of exact surveys* of those countries, many parts of which have not been surveyed at all, and others so imperfectly that the charts and maps thereof are not to be depended upon . . . For these reasons . . we recommend . . in strongest manner that no time should be lost in obtaining accurate surveys of all your Majesty's North American dominions . . . and to effectuate this purpose submit . . that such dominions should be divided into a Northern and Southern District with a Surveyor General of Lands to be appointed for each . . . lay before your Majesty for your consideration the annexed proposals offered us by Captain Samuel Holland who has great knowledge of the northern parts of North America, who is a brave and active officer, able engineer and a skilful surveyor, as shown in the accurate map he has made of the settled parts of . . . Quebec . . . [and] these proposals arise entirely from Captain Holland's zeal for your Majesty's service, *as he desires no additional emolument*, being well satisfied with your Majesty's gracious intention of appointing him to the office of Surveyor General in the Colony of Quebec . . . the extraordinary expenses which he proposes for this service are perfectly reasonable and necessary [so] we recommend that two sets of instruments in his estimates [see below] should be allowed, lest the work should be interrupted by any accident happening to any of them . . ." (author's italics)

"Estimate of Expenses Attending General Surveys of His Majesty's Dominions in North America for the year 1764:*

	£	s.	d.
"To an allowance for a Deputy Surveyor at Quebec during the time the Chief Surveyor is employed in making surveys in other parts of the northern district	100	0	0
"To two assistant surveyors to be employed in the general survey at 7s per day each	254	10	0
"To one draughtman at 5s per day	91	5	0
"To extraordinary expenses for horses and guides	100	0	0
"To an allowance for two sets of proper instruments for the surveyor of the northern districts	416	15	0

In the light of these strongly worded, detailed and urgent representations George III moved swiftly. On February 10 the King approved the submission, adding his royal directions to the Admiralty to furnish an armed vessel and boats for this service. It was an impressive example of kingly wisdom managing to provide a challenging job for an able man. Holland was instructed by the Board to survey Prince Edward Island, or, as it was then known, Île St. Jean, as well as the Magdalen Islands and Cape Breton Island in that order. He was to submit a full report to accompany the completed survey maps. These lands were given precedence in the matter of surveys and mapping because of the importance of their fisheries. With four principal assistants, including Thomas Wright (later to become Surveyor General of Prince Edward Island) Holland and a crew of forty sailed from England on the *Canceaux*, a 200-ton vessel fitted out by the Board for survey work. The *Canceaux* was placed under the command of Lieut. Henry Mowatt.

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*Capt. Holland's salary was set at £365 per year.

Holland had been entrusted with the signal task of carrying to Governor James Murray royal instructions on the procedures to be followed in organizing the civil government of the province. When the *Canceaux* was delayed in the Gulf of St. Lawrence by stormy weather, Holland impatiently pressed on to Quebec by boat and on horseback, reaching the capital ten days ahead of the survey vessel. Murray must have been suitably impressed by these dramatic developments and by Holland's part in them. In any case the Governor lost little time in appointing Capt. Holland a member of the newly-established Legislative Council of the Province of Quebec. The Council's first meeting on August 13, 1764, was attended by the Surveyor General.

Within three weeks of that meeting Holland made one of the shrewdest choices of his life when he appointed, on September 8th, John Collins of Quebec as Deputy Surveyor General "for the admeasurement, surveying and setting out of roads and lands in the Province of Quebec agreeable to my instructions . . . as annexed. . ."[1] Although this appointment was not formally confirmed by commission from the Governor until May 2, 1775, no more satisfactory man could have been found to perform the deputy's duties competently and conscientiously.[2] Incidentally, power was given to Collins on May 17, 1784 by Governor Haldimand, to administer oaths.[3]

Information on the early life of Collins is scanty. He is most often described as an English merchant who came to Quebec in 1759. Yet it is certain he must have had some previous surveying experience. A revealing glimpse of some of the factors which influenced Holland to select Collins is found in a letter of November 20, 1764, written to John Pownal by the Surveyor General when in Fort Amherst: "Mr. Debares [sic] who I had proposed to have been my Deputy surveyor in the Province of Quebec. is employed by my Lord Colville at 20 shillings per day, in surveying that part of the Coast of Nova Scotia between Halifax and Cansoe, and as the province could not be Without a Surveyor I have appointed in his room Mr. John Collins, a Gentleman qualified for the business. He has been imployed for many years as a Deputy Surveyor in the Southern Colonys and was recommended to me by Governor Murray and several other Gentlemen. He will be always Ready to receive your commands during my absence". When Holland travelled in the field on various survey projects John Collins administered the office in Quebec and while Holland was out of the country on business, Collins acted as Surveyor General. In addition he conducted numerous surveys himself and continued to perform in these roles until his death on April 15, 1795.

Following the completion of his special mission to Quebec, Holland and his staff of surveyors proceeded to Île St. Jean which the English already were calling St. John Island. Not until the end of the century was the name Prince Edward Island formally bestowed on this "Garden of the Gulf". The *Canceaux*, which had undergone repairs at Quebec, carried them to what is now known as Hillsborough Bay, named in honor of the then British Secretary of State. The party arrived on October 5, 1764. On this undertaking Holland's assistant surveyors were Lieuts. Robinson, Haldimand, Carleton and Wright. Holland's formal instructions declared "that in the survey the greatest precision and exactness will be required and expected, the latitudes and longitudes of the most important places must be settled by just astronomical observations; the depths of water and soundings, as well as the coast within the harbours, must be taken with the greatest care and every remark made which contend to the security and information of such of His Majesty's subjects as may navigate those seas".

At the time of his first landing on St. John Island Capt. Holland had no clear conception either of the true size of the island or of the number of its bays and rivers. At about this stage of the project serious difficulties began to crop up between Holland and Mowatt, the ship's commander. Holland had applied to Mowatt for the use of some small craft, to be manned by seamen from the *Canceaux*, to assist in the prosecution of the surveys and the soundings. But the Surveyor General was told by Mowatt that he had orders himself from the Admiralty to make observations of his own and that he could not spare either men or boats. Holland was angered over this pronouncement. He seriously doubted the commander's ability or capability to make proper surveys. Mowatt's motives in adopting this hostile attitude remain obscure but the trouble may have had its main source in the fact that whereas Mowatt was operating under the Lords of the Admiralty, the Surveyor General was being employed by the Lords Commissioners of Trade and Plantations. Initially, then, jealously and rivalry may have been at the root of these clashes.

Capt. Holland, already somewhat experienced in the bitter results of lack of cooperation between two branches of the armed services in wartime conditions, immediately made known the unhappy situation to Lord Hillsborough in London, to Lord Colville, Naval Commander of His Majesty's warships in North American waters and to Governor Wilmot of Nova Scotia in Halifax. It was evident that Holland was not prepared to take lightly any challenges to his authority. Lord Colville promptly extracted the heat from the conflict by letting Lieut. Mowatt know in very clear terms just where his duties rested in connection with this survey project. "Your people were raised," wrote His Lordship, "to be employed by Captain Holland and I can see no reason whatever why they should expect to be put on a footing with his other assistants in regard to pay . . . [I] recommend to you in the strongest terms *to maintain perfect harmony with Captain Holland,* to look upon yourself as a joint labourer with him and to suffer no such distraction as ship's duty and surveyor's duty to exist, but one and all, with heart and hand, to pursue a cause which is so much the object of His Majesty's attention and care". (author's italics)

This excellent and timely advice completely mollified Holland and had a salutary and lasting effect upon the commander of the *Canceaux*. After that effective communication the Chief Surveyor had no more trouble with Mowatt and, in fact, later on in the project expressed sincere gratitude for the valuable help he had received from the commander and crew.

It was Capt. Holland's original intention to conduct his surveys on the ice during the winter months but the weather proved so severe that one soldier was frozen to death and several lost fingers and toes from frostbite. But Holland and his aides were not kept completely inactive during this period and occupied themselves in the tasks of completing original maps of Quebec lands that the Surveyor General had brought along. Thus on March 4, 1765, Holland wrote to Secretary John Pownal: "I also propose to send a set of plans of the survey of Canada by a scale of two thousand feet to an inch with an index by a small scale. It will contain 62 sheets . . . Having found the great expedition of and convenience of the plane table in the survey of harbours and rivers preferable to the Theodolite or Circumferentor, I have wrote [sic] to Mr. Cumberland to provide me with three for the ensuing season, there being many surveys in the hands of the provincial surveyors".

Again in the following month Holland wrote to the Secretary of the Board of Trade and Plantations: "The cold here has been as intense as in any part of America I have seen, with sudden intervals of rain and soft weather. In this place snows are frequent, attended by thick weather, which makes astronomical observations very difficult; at other times when it is clear, it has been at the same time so severe as to oblige us often to quit the telescope to prevent the ill consequences of being struck by the frost . . ."

Frost was not the only affliction of the flesh that they were called upon to endure. Holland reported to Pownal: "I am also informed that in The Summer the Musquitos are so very plenty and troublesome that neither Man nor beast can withstand them in the woods. However I shall endeavor to get the better of all these difficulties . . ."[4]

On February 15 Holland commenced the island surveys, employing four parties in all. Lieut. Robinson and Holland himself finished the North East River section, surveying the carrying place, Savage Bay to St. Peters. Lieut. Wright surveyed from St. Peters to Governor's Islands, then proceeded to Malpeque. Lieut. Robinson surveyed towards Bay Fortune eastward and from thence to Three Rivers, later Georgetown.

As part of his April letter to Secretary Pownal, Holland states: "Our travelling equipage consists of a sledge of a foot in breadth, by six feet in length, upon which are beaver skin coats, a buffalo or bear skin, a blanket, canteens and about eight days' provisions, each drawn by a single dog, which we have purchased for that purpose from the Acadians, but as the chainmen are not able to carry their provisions . . . I have found it necessary to hire an Acadian for each of the gentlemen". In the previous October Holland had written: "My whole party for carrying the chain, camp, colors, etc., amounts to fifteen men, myself and assistant surveyors, gentlemen, volunteers and servants, thirty-one in all".

A serious breach of army discipline was recorded during this period of the survey when a soldier, John Haddock, of the 60th Regiment, who had charge of Lieut. Wright's instruments, was ordered by his superior to go about a mile for some missing parts. He replied, "Damn my blood if I will!" During the subsequent court martial the man admitted his guilt and was sentenced to 400 lashes by the cat o' nine tails. On the intercession of Lieut. Wright, however, the sentence was not carried out. Thus on July 16, 1765, ended what was probably the first British court martial on the island.

The hard conditions of weather and wilderness posed some formidable problems for Capt. Holland apart from those related directly to the survey operations. Not the least of these "unofficial" problems was the provision of a dwelling resistant to icy winds and deep snows. The presence of Mrs. Holland on the island lent some urgency to the task. She had insisted on accompanying her husband and must have been one of the very few wives of Canadian Surveyors General who achieved the ultimate distinction of travelling with her husband "to the field". Official records indicate that this structure cost Holland £50. It was heated by a stove brought from Quebec. As soon as adequate living quarters had been constructed at Observation Cove (now Holland's Cove) across the harbor from Charlottetown, the couple moved in. This modest structure continued to be their home during the course of most of these pioneer maritime surveys. Two children were born to the Hollands on the island, a son, John Frederick, and a daughter, Charlotte. The birth of a son marked him as the first British subject to be born on St. John Island.

"In many parts around the island is rough steep coast from 40 to 60 feet high", Holland reports, "composed of stratas of soft red stone which, when exposed to the air for some time, becomes harder and is not unfit for building. Wherever this sort of coast is, it diminishes considerably every year upon the breaking up of the frost, which moulders away a great part of it. It may probably be owing to this cause that the sea betwixt the island and the continent is frequently of a red hue, and for that reason by many people called the Red Sea; on the north and southeast side it has received some additions by the banks of sand which the sea has thrown up . . . With proper care the (soil) produces most kinds of grain, barley, wheat, oats, peas, beans, etc., also cabbage, cauliflowers and potatoes — very good in abundance, carrots, turnips, etc." Holland goes on to describe the best harbors for trade and fisheries as well as reasons for the location of principal towns: "The capital, called Charlottetown, is proposed to be on a point of the harbor betwixt York and Hillsborough Rivers, being one of the best, and nearly a centrical [sic] part of the island, has the advantages of an immediate and easy communication with the interior part of the island by means of three fine rivers of Hillsborough, York and Elliot. The ground designed for the town and fortifications is well situated upon a regular ascent from the water-side; a fine rivulet will run through the town; a battery or two, some distance advanced, will entirely command the harbor . . ." There were recommendations also from Captain Holland regarding the establishment of sites for Georgetown and Princetown. The latter, however, was never built.[5]

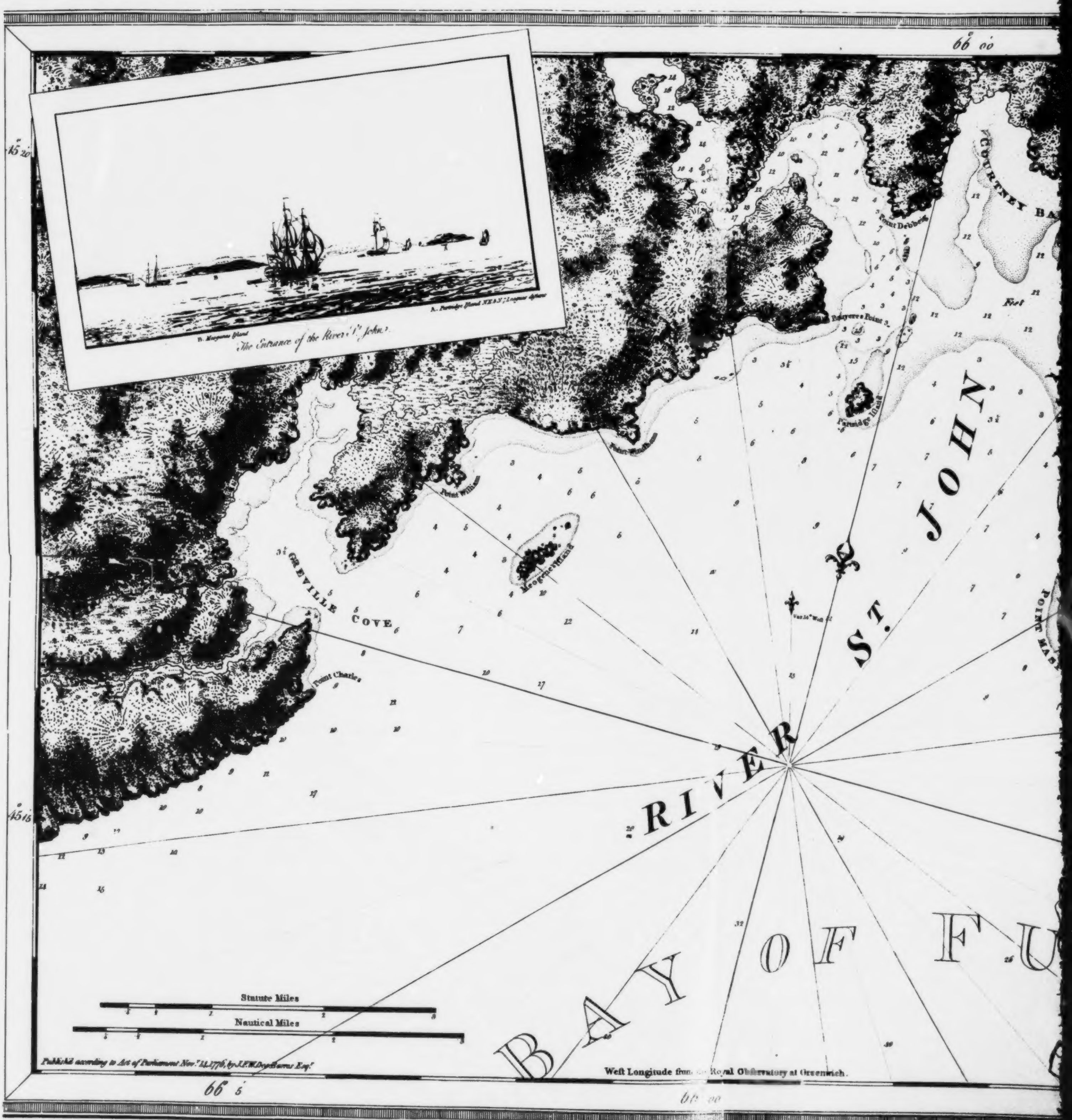
By October 4, 1765, the island surveys had made such progress that Holland was able to send Lieut. Robinson to England with large and small maps of St. John Island as well as with a complete plan of the Magdalens and a set of completed maps of the settled areas of the St. Lawrence River basin. Following the completion of the survey operations on St. John Island, it was divided into 67 lots or townships, each lot of 20,000 acres. Holland's reports had served to stir up a certain amount of land speculation fever in England and the requests for grants of land on the island became so numerous that with the exception of two or three townships, a drawing was arranged and the holdings distributed to favored personages by lots drawn in the course of a single day. Surveyor General Holland was awarded Lot No. 28, fronting on the Tryon River. This property remained with his descendants for generations. Holland discontinued residence on the island after 1769.

Capt. Holland and his assistant, Lieut. Frederick Haldimand, had completed the survey of the Magdalen Islands in the season of 1765. In December of that year, while surveying Cape Breton Island, Haldimand "was drowned". This promising young man, only 24 years of age, was a nephew of Major General Frederick Haldimand, a future Governor of Canada. Holland was deeply affected by the passing of the youthful surveyor. He regarded Haldimand as an accomplished mathematician and he mourned for years the loss "not only of a friend but my principal assistant in astronomy in which he [had] made surprising progress".

Back in Quebec Collins had not been idle. He reported on May 21, 1765, to Governor Murray that he had fixed the point on Lake St. Francis where the 45th parallel of latitude intersects the southeast shore of the lake. Apparently Collins also proceeded with the survey of the boundary between the provinces of Quebec and New York in 1765 and 1766. He was also employed on surveys in the Gaspé and in the vicinity of Baie des Chaleurs.

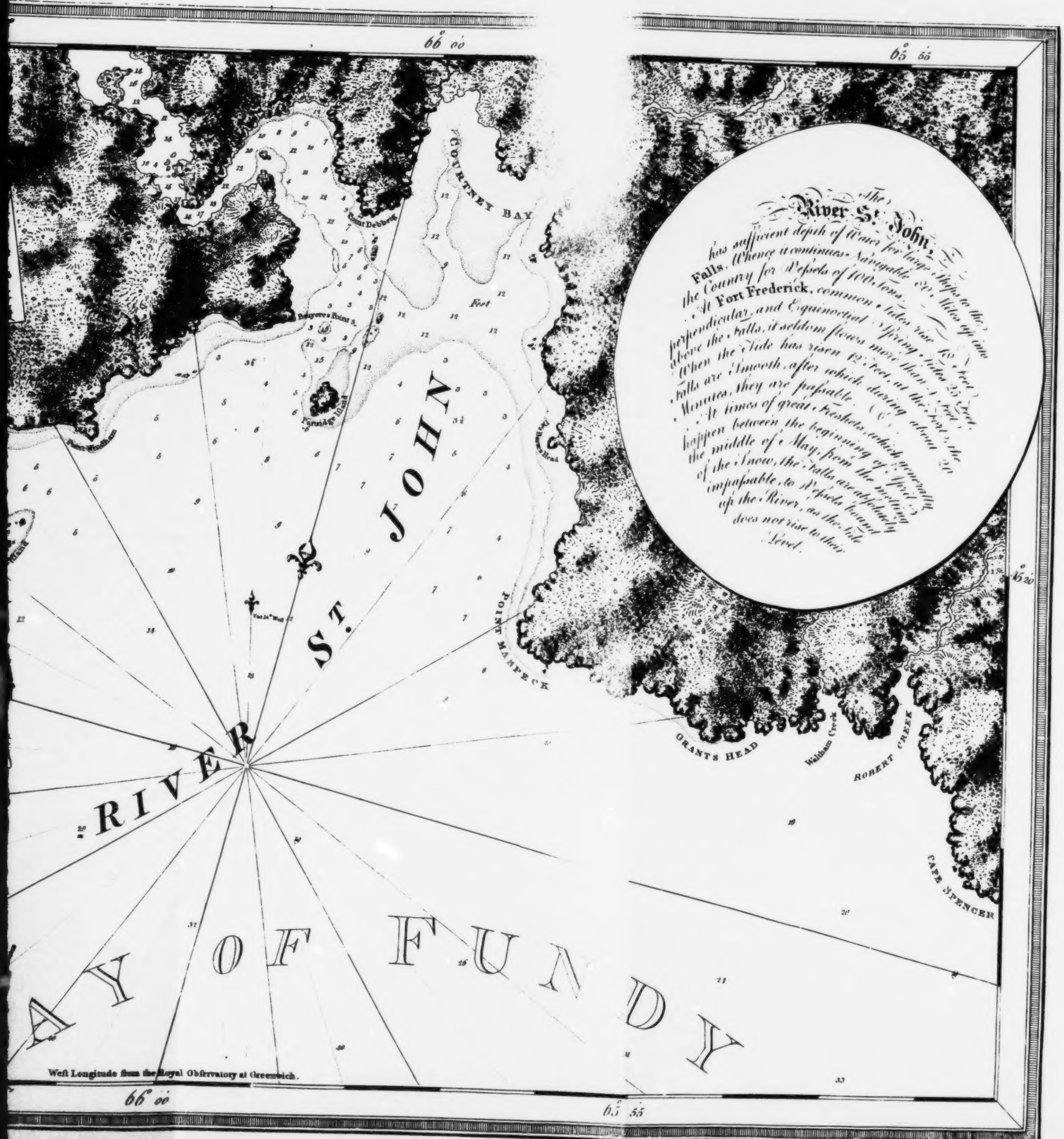
By July, 1767, Holland had sent completed survey plans of Cape Breton Island to London, England. Following this action he worked along the west coast of the Gulf of St. Lawrence and along the St. Lawrence River. During his Cape Breton surveys Holland arrived in Louisbourg on October 26, 1765, some seven years after his landing under hostile fire in that same locality. He was joined there by Lieut. Pringle and Lieut. Wright, a pair who had surveyed the west coast of Cape Breton Island.[6]

In Louisbourg Holland was well received by the garrison commander who provided



66° 00
45° 20
45° 15
The Entrance of the River St. John
B. Meogenes Island
A. Partridge Island N.E.b.E. 1 1/2 League distant
COURTNEY BA
Point Debbec
Fort
Partridge Island
Point William
Meogenes Island
GREVILLE COVE
Point Charles
RIVER ST. JOHN
BAY OF FU
Statute Miles
Nautical Miles
West Longitude from the Royal Observatory at Greenwich.
66° 5'
66 00

Publish'd according to Act of Parliament Nov. 11, 1776, by J.F.W. Des Barres Esq.


66° 00
65° 55
The River St. John
has sufficient depth of Water for large Ships to the
Falls. Whence it continues Navigable 80 Miles up into
the Country for Veſsels of 100 tons.
At Fort Frederick, common Tides rise 18 feet
perpendicular, and Equinoctial Spring Tides 25 Feet.
above the Falls, it seldom flows more than 4 feet,
When the Tide has risen 12 feet, at the Fort, the
Falls are Smooth, after which during about 20
Minutes, they are paſsable. &c.
At times of great Freshets, which generally
happen between the beginning of April, &
the middle of May, from the melting
of the Snow, the Falls are absolutely
impaſsable, to Veſsels bound
up the River, as the tide
does not rise to their
Level.
COURTNEY BAY
Point Debbeig
Negro Point
Partridge Island
Feet
POINT MASPECK
GRANTS HEAD
Waltham Creek
ROBERT CREEK
CAPE SPENCER
RIVER ST. JOHN
BAY OF FUNDY
45 20
Weſt Longitude from the Royal Obſervatory at Greenwich.

y J. F. W. DesBarres, 1776, published in The Atlantic Neptune. Courtesy of the Publ him with "the best quarters in town". While in Louisbourg Holland made arrangements for the provision of necessary equipment and for supplies for his various survey parties. He also added Ensign Sproule of the 59th Regiment to his staff of helpers, continuing astronomical observations on Cape Breton Island. In the spring of 1766 three survey parties were set in motion and by autumn the general outline of the island had been traced and the facts gathered for a proper description. Ensign Sproule remained with Holland to finish the survey of Bras d'Or Lake and other lakes in the region. Holland himself did not complete work in Cape Breton until the summer of 1767. In all, by 1767, he had sent to the Board of Trade and Plantations five complete plans of Cape Breton Island, three on a scale of two miles to the inch; two on a scale of 4,000 feet to the inch. Incidentally, none of these sketches are to be found anywhere today.

In 1767 Lieut. Wright led a party to survey on Anticosti Island. In 1768 the north side of the St. Lawrence from Baie St. Paul to the Saguenay River and up that river as far as Lake St. John, was surveyed by Lieut. Blaskowitz. The south side of the St. Lawrence from Mount St. Louis to the Gaspé was surveyed by Ensign Sproule and later Sproule and Wright surveyed a stretch of Labrador coast.[7]

Today at Holland's Cove, across the harbor from Charlottetown, a plaque recalls the early labors of surveyors on what is now Prince Edward Island. Mounted on an attractive stone cairn the plaque declares: "Following the Treaty of Paris, 1763, the British Government ordered a systematic survey of its possessions in North America. Captain Samuel Holland was placed in charge of the district north of the Potomac and because of the importance of its Fisheries, was instructed to begin with Prince Edward Island. In October, 1764, he established headquarters at Holland Cove and completed his survey in 1765".

Surveyor General Holland will be remembered always as the author and finisher of the first organized scientific land and water surveys on the northern half of North America. Thus far in our narrative we have followed him and his associates through the initial surveys of Prince Edward Island, the Magdalen Islands and Cape Breton Island. These achievements were, of course, in addition to surveying accomplishments in the settled parts of Quebec province. Later on in this account Holland's activities as Surveyor General of the Northern District[8] are evaluated as he travelled along the Nova Scotian and New England coasts and as far south as New York and New Jersey. The American Revolutionary War, now looming darkly on the horizons of the New World, was to exercise a profound influence on Holland's personal fortunes. Ahead of him lay renewed administrative efforts as provision had to be made for the influx into Canada of the United Empire Loyalists. Nova Scotia, New Brunswick, the Eastern Townships of Quebec, Prince Edward Island and, ultimately, Upper Canada, were to feel the welcome impact of the newcomers. Presiding to a large extent over their fate in the new land was this remarkable man, Samuel Holland, destined to give much needed leadership during a most significant formative period in the development of Canadian nationhood as we know it today.

After the capitulation of Quebec, Lieut. Joseph F. W. DesBarres was employed on surveys in that town and in its immediate vicinity. On paper he made a representation of the Battle of the Plains of Abraham and took soundings in Quebec harbor and basin. This work was later incorporated in a larger plan and published in *The Atlantic Neptune*, a work that was to establish for DesBarres a permanent name in the realms of surveying and mapping. After the capture of Montreal early in September, 1760, DesBarres was dispatched to Nova Scotia with Col. Bastide to make surveys and plans and to complete estimates concerning the fortifications and dockyard at Halifax.

When Col. William Amherst in 1762 led a successful English expedition against French-held St. John's, Newfoundland, Lieut. DesBarres served under him, probably with the Royal Americans, as an engineer and as Quartermaster General. Col. Amherst, commanding troops in New York, had mustered a force of some 1,700 men. On ten transport vessels the expedition made rendezvous with Admiral Colville's squadron off St. John's on September 11. On September 13 a landing was made at Torbay and by September 19 the French surrendered. This was the last battle in the Seven Years' War between French and English in North America. DesBarres, after this action, returned to Halifax carrying with justifiable pride official appreciation of his services in the campaign and its aftermath.

In a petition DesBarres submitted in later years (January 28, 1794)[9] to the Lords of the Admiralty he modestly drew attention to his services with Wolfe at Louisbourg mentioning that "in the course of the siege I was ordered to join the Corps of Engineers wherein I had frequent occasions to apply my small talents". Continuing in that same communication DesBarres states, "Then in 1762 I was ordered under command of Colonel [William] Amherst in the expedition for the retaking of St. John's in Newfoundland where . . . after alternate duties in the line as an engineer and as Quartermaster General I had the honor to be particularly thanked and, at the close, sent to survey some of the principal harbors and posts of that Island and to project designs for their Defence".

In 1763 Rear Admiral Spry, in command of the fleet in America, represented to the Admiralty that the coasts of Nova Scotia and of the American colonies were very imperfectly charted. He proposed that accurate surveys be made and recommended that DesBarres undertake supervision of this formidable project. Lord Colville, who succeeded to Spry's command, was instructed by the Admiralty to employ DesBarres on these surveys. The surveyor's salary was established at twenty shillings a day with certain added allowances for equipment and other items essential to the prosecution of the surveys. DesBarres was occupied on this project for ten years, 1764-1774.

This same ten-year period featured the appearance in Canada of the first newspaper, the *Quebec Gazette* (1764), to be published in the province of Quebec; the appointment of Sir Guy Carleton as Governor General of Quebec (1768); of Samuel Hearne's journey to the Coppermine (1769-72); of the birth of David Thompson in London (1770); of Capt. Cook's famous first and second voyages of discovery; of survey work on the 45th parallel between Quebec and New York provinces; and of land surveying work in Virginia by George Washington. It was a ten-year period that ended in the passing of the Quebec Act; in the building by Samuel Hearne of Cumberland House (a Hudson's Bay Company interior post) and by the birth of W. F. W. Owen who contributed so greatly to Canadian hydrographic achievements.

On the advice of Lord Howe who impressed King George III (crowned in 1761) with the vast importance of the Atlantic coast surveys not only to naval vessels but to merchant ships, the sovereign ordered that charts and sailing directions of these waters be published. The surveys occupied ten years, as did the work of compiling, editing and printing. In fact, at one stage of this prolonged and exacting task, namely in the years 1776-79, DesBarres supervised a staff of more than twenty assistants. From 1774 to 1784 DesBarres remained in London revising and improving his own material as well as that provided him by army and naval officers who assisted in the actual coastal surveys.

The practical value of *The Atlantic Neptune*, as the published compilation was entitled, is beyond precise calculation. The charts became a standard guide for navigators in waters off the eastern coast of North America. The production, compilation, printing and engraving of *The Atlantic Neptune* must surely be regarded as one of the most remarkable products of human ingenuity, determination and industry to appear during the 18th century. The artistic excellence of the sketches is very high and this quality was solely due to DesBarres. It must be admitted, however, that he incorporated in the publication the work of others, including that of Major Holland, without always attributing it to its proper source.

The several editions vary considerably in their content. No two copies contain exactly the same collection of plates. In fact, no complete list exists of the plates issued from time to time under the title of *The Atlantic Neptune*. One does not need to rely upon the not-too-objective assessment of DesBarres of his own accomplishment, nor, for that matter on any British valuation of his work. *L'Esprit des Journaux*, Paris, 1784, published this eloquent tribute: "There has recently been placed on sale at The Hague by P. F. Gosse, Court bookseller and printer, a superb Atlas which we take this first opportunity to describe in detail. This work, which is indispensable for the navy, is the result of 19 years labour and has cost the English government more than £100,000 sterling, in addition to the considerable expense which the author himself has discharged for its execution. The work is in the highest degree of beauty and superior in every thing to the kind that has heretofore been published."

The Public Archives of Canada possesses in Ottawa what is known as the Amherst Copy of *The Atlantic Neptune*, a presentation to the Canadian Archives by Earl Amherst. Volume One of this edition includes the sea coast of Nova Scotia, with soundings, together with remarks and directions for navigation and pilotage. In addition it contains similar survey work along the coasts of New England, New York, Jersey [sic] and the "Gulph" of the River St. Lawrence, published in 1778. There are sketches or views of the North Point of Grand Manan Island, of Camp Belo [sic] Island and of Mechios Mills, published in 1777. Volume Two of the Amherst Copy contains material on the sea coasts of Nova Scotia including the southwest coast (1779) and Halifax harbor (1779). Volume Three contains charts of the coasts and harbors of New England from surveys of Samuel Holland and his aides Charles Blaskowitz, James Grant and Thomas Wheeler.

The title page of Volume One announces: "The Sea Coast of Nova Scotia exhibiting the diversities of the Coast and the Face of the Country near It. The Banks, Rocks, Shoals, Soundings, etc. Together With Remarks and Directions for the Commencing of Navigation and Pilotage. Surveyed by Order of the Right Honourable the Lords Commissioners of the Admiralty by Joseph Frederick Wallet DesBarres, Esq.".

The Preface is interesting. "Whatever has a tendency to perfect the Theory or facilitate the Practice of Navigation, must ever merit the Attention and cannot fail meeting with the Protection of a People, whose Prosperity is so especially connected with Maritime Commerce, and whose very Existence as a great and powerful Nation must ultimately, if not solely, depend upon the superiority of its Navy—Impressed with the justness of this Idea the Author ventures, with greatest Confidence, to lay before the Public the present laborious and useful Work—Nova Scotia is situated between 43 and 48 degrees Latitude North and between 60 and 80 degrees Longitude West from London" . . . DesBarres then proceeds to discuss forest wealth, agricultural potential and the fisheries. He continued: "The Dangers to which the Author has often been Exposed in the Execution of this important and arduous Undertaking, as well as for the sake of greater Accuracy, Perpescuity and Dispatch, put him in the Necessity of

Furnishing himself with repeated Sets of Instruments, Astronomical and Geometrical, constructed to his Purpose, and rendered more perfect from the many Improvements and additions the long course of his experience suggested . . . The Climate not admitting to the Use of Instruments more than Six Months in the Year, added to the Frequent Interruptions by Fogs and precarious weather, unavoidably made tedious a Performance in which Accuracy and Certainty were the *prima desiderata* and has rendered many years necessary to compleat it for Publication . . . It is also of great and lasting Importance to have the correct Survey of the Isle of Sable, composed of Sand, with two Bars often breaking mast-high for Seven Leagues, exposed to the Western Ocean and covered with Wrecks, where thousands have perished for want of knowing the Soundings . . ."

Then DesBarres provides a glimpse of the dangers he faced in the performance of his task: "This Survey the Author has accomplished at the Hazard of his life, the Surf upon the Shores admitting no Boats to approach without the greatest Risk . . . a considerable part of Two Years was employed in Sounding around the Island and landing at different times to survey and ascertain the Latitude, Longitude, etc. . . . After 16 years of unremitting Exertions of the Author's Diligence and Abilities (there) is now ready . . ."

In a page of General Remarks is found an echo of more martial days: "The Lighthouse and Town of Louisbourg, on making that part of the Island (of Cape Breton) are immediately seen. The Coast to the Westward continues Rocky on the shore with a few banks of red earth and appears less barren".

Not only James Cook but the second man to be named Hydrographer to the British Admiralty, Capt. Thomas Hurd, benefitted immeasurably by lessons in nautical surveying received early in their careers from Samuel Holland and Joseph DesBarres. DesBarres may have lacked the tactfulness of Holland, the scholarly imagination of Dalrymple (first Hydrographer to the Admiralty), and the exploring zeal of Cook but for sheer skill and versatility as a surveyor and draftsman DesBarres had no equal in his time. Delicacy of touch and of balance featured all his sketching work. By 1784 this productive side of his life had nearly concluded and he entered into another sphere of public service. He had yet to serve as the Lieutenant Governor of Cape Breton Island (1784) and as Prince Edward Island's third Lieutenant Governor (1805-13) but his chief claim to fame and his greatest contribution to Canadian progress must remain his production of *The Atlantic Neptune*.

Of the triumvirate of notable pioneers who dominated surveying and mapping on Canadian land or in Canadian waters for the years following the Peace of Paris (1763) Capt. Cook was the only one to survey on both the Atlantic and Pacific coasts of Canada. James Cook was the second child of a large family living in the village of Marton-cum-Cleveland in Yorkshire. From modest economic circumstances he rose, chiefly by his own abilities, dedication and exertions, to the rank of Captain in the Royal Navy and also to the highest place in his age as a navigator, marine surveyor, scientific observer and discoverer of new lands.

Born on October 27, 1728, Cook's career spanned the period between the death of Newton and the birth of Darwin. In the years represented by these three influential lives there occurred a revolutionary unfolding of fundamental scientific facts and laws of nature pertaining both to this world and to the universe. There was, as well, a growing comprehension by educated people of the significance and inter-relationship of these basic facts and principles.

Cook's father was a day laborer and James found it necessary, in order to realize his ambitions, to educate himself in mathematics, astronomy, navigation and cartography as well as in the rudiments of medicine. A career in the British Navy appealed strongly to him. In addition to an eager and gifted intellect he had two helpful assets, namely, good health (so far as is known Cook was seriously ill on only one occasion)[10] and that rare quality in seafarers of his day, the uncanny ability to "smell" land in what appeared to be unbroken ocean.

After a period of training in the merchant service of his country Cook joined the Royal Navy in 1755 at the age of 27. His first tour of duty was aboard H.M.S. *Eagle* and he soon rose from the rank of able seaman to that of sailing master, a warrant officer who specialized in navigation and ship-handling. Though not technically a Lieutenant, a sailing master or Master was usually allowed by custom to live and eat with ship's officers of that rank or higher.

Cook joined H.M.S. *Solebay* as Master on July 30, 1757 and was transferred to H.M.S. *Pembroke* in that capacity in October of that same year. He stayed two years with the *Pembroke*, serving as Master under Capt. John Simcoe at the sieges of Louisbourg and Quebec. While with the *Pembroke* Cook assiduously studied mathematics, Euclid, astronomy and marine surveying, greatly helped by the guidance and instruction provided by Samuel Holland and Joseph DesBarres.

Following the transfer of Canada to the British Crown, it was realized by Commanders of the Royal Navy that available hydrographic information and coastal mapping generally was quite inadequate for safe navigation in the eastern waters of northern North America. Lord Howe and other leaders of the navy pressed energetically for immediate publication of any maps and charts based on accurate surveys of these areas and forwarded to London. It was this growing and urgent need that made possible the remarkably productive activity in surveying and marine charting in the last half of the 18th century on the part of Holland, DesBarres and Cook.

Admiral Saunders at Quebec ordered James Cook to be transferred from H.M.S. *Pembroke* to H.M.S. *Northumberland* following the capitulation of Quebec. Cook was thus enabled to remain in Canadian waters and to continue his marine surveying work. In 1760, while with the *Northumberland* as its Master, Cook studied carefully the St. Lawrence River in the general area of Quebec. In fact, chart work on the river attributed to Cook's operations in 1759 was actually accomplished in the summer of 1760. The navigation of the St. Lawrence River was so studded with hazards at the time, especially for English captains and pilots, men strange to these parts, that Cook was ordered to survey stretches of the river below Quebec. He executed the whole business with characteristic diligence and skill. The resulting chart was published in London, complete with soundings and sailing directions. As additional evidence of his rising reputation as a surveyor there appeared in R. Sayers' *North America Pilot*, published in London in 1775, an introduction by Cook as well as surveys in Newfoundland waters by him and his assistant Lane. So excellent was their work that the information remained in use until Kerr's amendments were made almost a century later.[11]

In a letter written by Lord Colville in January, 1761, the Admiral made direct reference to Cook's surveying in the St. Lawrence. He mentions that he, the Admiral, "had directed the storekeeper to pay the Master of the *Northumberland* £50 in consideration of his indefatigable industry in making himself master of the pilotage of the River St. Lawrence".

From 1760 to 1762 the *Northumberland* was based on Halifax and during this period James Cook employed his opportunities to survey Halifax harbor and adjacent coastal parts during summer months. In September, 1762, the *Northumberland* sailed to take part in Admiral Colville's naval action in the Newfoundland campaign. In a despatch to the Lords of the Admiralty dated October 25, 1762, Lord Colville states that "an army engineer called DesBarres was sent to the Island of Carbonera to plan its refortification. Mr. Cook, Master of the *Northumberland*, accompanied Mr. DesBarres. He had made a draught of Harbour Grace and the Bay of Carbonera, both of which are in a great measure commanded by the island, which lies off a point of land between them. Hitherto we have had a very imperfect knowledge of these places but Mr. Cook, *who was particularly careful in sounding them*, has discovered that ships of any size may lie in safety both in Harbour Grace and the Bay of Carbonera". (author's italics)

This particular survey, in fact, played an important and influential part in Cook's subsequent career. As a result of his exemplary conduct in the Newfoundland campaign and its aftermath, Cook was made a 3rd Lieutenant in 1762. In the following year, with an assistant, Edward Smart, he spent the summer and early autumn surveying St. Pierre and Miquelon, transferring from H.M.S. *Antelope* to H.M.S. *Tweed* as required. In fact Thomas Graves of H.M.S. *Antelope* had approached the Admiralty on at least four occasions in 1763 to have Cook appointed a full-time surveyor in Newfoundland waters. He was so appointed on April 19, 1763.

In 1764 Capt. Hugh Palliser was appointed Governor of Newfoundland. Palliser realized how vitally essential marine surveys were to the proper use of the island's coastal waters. He knew Cook well and entertained a high regard for him. Governor Palliser lost little time in locating a schooner *Sally* as a vessel suitable for surveying operations. He re-named it the *Grenville* and had Cook appointed as its sailing master and as naval engineer on June 14, 1764, for the purpose of carrying on the work of a "marine surveyor of the Coast of Newfoundland and Labrador". In addition Cook was provided with two able assistant surveyors, William Parker and Michael Lane. Cook spent the summer of that year surveying the northern parts of Newfoundland, returning to England for the winter months. In the 1765 season he surveyed waters of the Gulf of St. Lawrence as well as those along the Newfoundland coasts, returning to Deptford, England, where he spent the winter period completing work on his charts and in writing up related descriptions. It was in February, 1766, that he received Admiralty permission to publish these charts.

In April he returned to Newfoundland waters, surveying along the south and southwest coasts. On August 5th he observed an eclipse of the sun at Burgeo. His description of that phenomenon, submitted to the Royal Society and published in its *Philosophical Transactions* of 1767,[12] resulted in the bestowal on him of a society fellowship. This recognition proved to be the turning point of his naval career.

The scientific progress in the 18th century allied with an intensive British drive towards expansion, aroused in great measure by the resounding victories of the Seven Years' War, was providing the financial means for far-reaching sea explorations. What was equally important was the fortunate timing of these developments. Cook had succeeded in making a deep and favorable impression on both the Royal Society and the Admiralty at a time when the need for seamen-scientists was most urgent.

At the age of 39 Cook returned for the last time to Newfoundland waters in April, 1767. He had but eleven years of life left but he made every one of those years count in a very large way on the calendar of human achievement. His three world-famous voyages of Pacific discovery were yet to take place. But Cook's reputation as a navigator and surveyor of special genius had been firmly established in the Atlantic waters of British North America. That reputation had not been made without personal mishap. Sometime during this period of service the explosion of a powder horn maimed one of

Cook's hands.

Cook's maps and charts of Newfoundland were the first to provide an accurate representation of its west coast on which, for the first time, Point Riche was correctly placed. Cook also ventured, on his explorations, some distance inland in order to trace the Humber River as far as Deer Lake. Cook pioneered in giving a true delineation of the island coasts and the Strait of Belle Isle. On Burgeo Islands and at other places along the Newfoundland coast his survey markers may still be observed.[13]

Governor Palliser, in a letter dated February, 1767, wrote to the Admiralty summing up Cook's survey work: "Mr. Cook, appointed by . . . the Admiralty to survey the seacoast of Newfoundland and Labrador under my direction, having finished his chart of the southeast coast of Newfoundland, adjacent to the islands of St. Pierre and Miquelon . . . and upon a large scale of one inch to a mile, you will herewith receive the said chart, which he [is] pleased to lay before the Lords . . . of the Admiralty. He, having also the last year delivered to the Board his survey of the same scale, and having now prepared a chart of that part, together with a chart of the opposite part of the coast of Labrador, including the island and straits of Bell Isle; likewise another of the abovementioned surveys of a part of the south coast of Newfoundland, both upon a proper scale to be useful to the trade and Navigation of His Majesty's subjects, therefore, as the publication of the same I am of opinion will be a great encouragement to *new adventurers in the fisheries upon these coasts,* be pleased to move their Lordships to permit Mr. Cook to publish the same". (author's italics)

Cook sailed for England on October 23, 1767, and arrived at Deptford on November 15th. He began to prepare his charts for publication. Thus ended his connection with Newfoundland and the east coasts of Canada. It was eleven years, and in the year of his tragic death, before he returned to Canadian waters . . . over 4,000 miles distant and under circumstances vastly different from those governing his Atlantic activities. Admiral William J. L. Wharton, a distinguished Admiralty Hydrographer, speaking of Cook's Newfoundland surveys stated, "The charts he made during these years on the schooner *Grenville* were admirable. The best proof of their excellence is they are not yet superseded by the more detailed surveys of modern times. Like all surveys of a practically unknown shore, and especially when that shore abounds in rocks and shoals, and is much indented, they are imperfect in the sense of having many omissions. But when the amount of ground covered and the impediment of fogs and bad weather on that coast is considered and that Cook had at the most only two assistants, their accuracy is truly astonishing".

R. A. Skelton, eminent English student of cartography, has observed, "Cook's Journals testify to his flair for predicting the trend of a coastline and for discovering and interpreting its principal features . . . his charts are in general notably correct in outline and accurate in their latitudes". Errors that Cook made in calculating longitudes were minor, Skelton points out.

The British Admiralty was to continue for another century as the agency chiefly, if not entirely, responsible for hydrographic work in Canadian waters. But James Cook, in his four years in the vicinity of Newfoundland as well as in previous surveys in the River and Gulf St. Lawrence, so solidly established the traditions of devotion to duty and of reliability and precision of work that his high example continued to inspire and influence Canadian marine mapping for generations to come.

12

MARITIME PROVINCES SURVEYS AND THE LOYALIST INFLUX

"Peering in maps for ports, and piers, and roads . . ."
The Merchant of Venice, Act 1. Sc. 1.

The decade following the completion of Captain Holland's surveys in what are now known as Prince Edward Island, Cape Breton and the Magdalen Islands, was one of great political and economic upheaval in North America. For the purposes of this history possibly the most effective way to indicate the true nature and extent of the convulsions of that ten-year period, is to observe how these influenced the career of Canada's first Surveyor General.

In July, 1770, Holland set out from Quebec with all his assistants for the eastern coast of New England to continue a survey commenced by DesBarres. In December of that same year he wrote to Lord Hillsborough from near Portsmouth, New Hampshire. The concluding paragraph of the letter, in which he refers to what is now New Brunswick, has a prophetic strain:

"Supposing a Province to be erected there [actually this event came to pass just 14 years later] the Happiest Boundaries for it . . . would be the River St. John in the Bay of Fundy to the East and the Saco River with the New Hampshire Eastern Boundary to the west, agreeable to the sketch I inclose . . ." This report indicates that Holland and his aides were occupied on surveys along the coasts of Maine and New Hampshire. Holland's work connected up with that of DesBarres at the Strait of Canso and at the St. Croix and St. John Rivers. By 1773 this survey project had been extended as far south as Boston. Holland kept reporting from time to time to the President of the Board of Trade and Plantations on his progress. During this period he made Portsmouth the headquarters for his field operations.

In 1772 Holland resigned his army commission to concentrate upon his civil employment. The following year he resolved to make Perth Amboy in New Jersey his new survey headquarters and announced the intention to extend the surveys around Cape Cod to New London. The boundary between New York and New Jersey occupied his attention at this time as well as the boundary between Massachusetts and New York. At this stage of the project the Surveyor General felt that six more years would be required to complete the coastal surveys. While Holland was concentrating upon his boundary surveys in the States, the Quebec Act of 1774 was passed by the British Parliament, a measure extending the boundaries of the province and confirming the validity of the feudal landholding system there. The Act marked the failure of British authorities to unify and consolidate its North American colonies of Quebec and Nova Scotia.

In 1775 Holland was ready to run the line between New York and Massachusetts and was actually employed on this task when the Revolutionary War broke out in earnest. Holland rejected with indignation offers of certain military commands in the rebel army. Before long he was forced to make a dash for the coast to escape arrest. He managed to get away safely on a British vessel under the command of General Tryon, and by November, 1775, reached the shores of England. In his haste he had left his family and property at Perth Amboy "to the mercy of an unrelenting and enraged multitude" according to the language of a letter he wrote to General Tryon in later years (1784). His wife and children were removed to Boston where they remained until the city was evacuated by the British in March, 1776. It is thought that the Hollands then headed for Quebec.

An example of the vicissitudes experienced by his wife at this rather desperate time is disclosed in a letter written by Holland in 1791.[1]

". . . I should be loth [sic] to trust to any unskilful hands my capital set of instruments, consisting of all sorts necessary for carrying on a general survey, or making astronomical observations; [instruments] made by the best artists in London. They have already been proved by me in settling the longitudes and latitudes in the Northern District of North America, as inserted in the Philosophical Transactions, and with which Mr. Sproule and Mr. Wright ascertained the longitude and latitude of Gaspé and Isle of Anticosti. As they [the instruments] were much deranged by being removed from their boxes by Mrs. Holland to prevent them being carried off by the Americans, while she and her family were their prisoners in 1776, I was under the necessity of taking the principal ones with me to England where they underwent thorough repair in Mr. Ramsden's hands, except a quadrant of the old construction, which was left in my office, where it had been nearly ruined".

It was during his abbreviated exile in England that Samuel Holland found time to contribute four important papers to the Proceedings of the Royal Society of London, three of them related to astronomical observations near Quebec in 1769 and 1774.[2] During the winter of 1775 in England, Holland was employed by Lord George Germaine in compiling and preparing maps from his field notes. In March, 1776, His Lordship proposed that Holland return to America as an aide, with the rank of major, to General Heister, commanding Hessian troops. Holland promptly accepted and was commissioned a Major on March 4. He served in various capacities under Sir William Howe, Sir Henry Clinton and General Tryon, all stationed at New York.

In August, 1776, the Continental Congress decided to send an army down Lake Champlain and the Richelieu River with the aim of capturing Montreal. Not many months after the Quebec Act became legally effective, Montreal was occupied by

American forces on November 13. At this time a rather stirring escapade took place, one which involved several personages of significance in the story of Canadian surveying and mapping. Guy Carleton, who had been appointed Governor General of the province of Quebec in 1768, was in Montreal at this time but escaped down river evading American patrols, including vessels on watch at Sorel. The success of this stratagem is mainly attributed to the cool courage of J. B. Bouchette, the half-brother of Mrs. Holland. It was he who commanded the boat on which Carleton was hidden. After several narrow escapes Bouchette landed Carleton safely at Quebec. In a minor but none the less helpful way this feat marked the turning point in the grim struggle for the control of the destinies of Canada.

The separate armies of General Benedict Arnold and General Montgomery joined in an assault on Quebec, which they were ill-prepared with armaments to besiege effectively. A blockade of the city proved fruitless. A desperate attack in a fierce blizzard on the last day of 1775 reached its bitter climax in the death of Montgomery, the wounding of Arnold, the death of one hundred Americans and the capture of 400 others. Thus ended, in bloody strife and profound failure, this attempt to force Canada into a continental union and make it, in effect, the 14th of the original States.

So far as the Quebec habitant was concerned, Americans were regarded not as liberators but as likely oppressors. This attitude astonished and dismayed the invaders. They lingered on near Quebec until the spring of 1776 when a British fleet sailed up the St. Lawrence. Discouraged by this development the Americans made haste to depart for their homeland. By June 15 Montreal had been evacuated.

Just as their War of Independence proved to be a successful one for the United States, so did the experiences of 1775-76 mark an equally successful campaign for independence from any continental power by Quebec and Nova Scotia. The war left a heritage of bitterness among the English-speaking peoples of North America. If a Loyalist residing in the States had fought for the British side in the Revolution then his home and private property were confiscated. The plight of the non-belligerent who refused to side with the rebels was not greatly different. As a result Loyalists gathered in British-held towns or followed British armies. Others joined fighting units such as Butler's Rangers, the Queen's Rangers or any of the over fifty units organized during the Revolution to fight for the British cause.

On July 4, 1776, the rebellious American colonies made known to the world their Declaration of Independence. At this time Major Holland, in all probability, was serving with Sir William Howe's forces in the New York and Philadelphia areas. On the day of the Battle of Bunker Hill in 1775 a 23-year-old ensign of the 35th Regiment, one John Graves Simcoe, landed at Boston. Both young Simcoe and Samuel Holland, who had served with the ensign's father at Louisbourg seventeen years earlier, were now under the same British commander-in-chief. Despite the difference in their ages it is likely that these two struck up a friendship during this campaign, a close relationship that continued to flourish in later years.

Major General Sir Frederick Haldimand, late in 1777, had been named Governor General of Quebec Province in succession to Sir Guy Carleton. In the following year he requested that Major Holland come to Quebec to resume his duties as Surveyor General, duties interrupted so abruptly three years before. Holland returned to Quebec in 1779 and began to organize his office there as well as his program of surveys. In 1780 he purchased the Holland farm, a property of 200 acres, northwest of the Plains of Abraham. It was land belonging to M. Jean Taché, author of what has been regarded generally as the first published poem by a Canadian, *Tableau de la Mer*. The mansion of the estate had been occupied as his headquarters by General Montgomery during the unsuccessful American siege of Quebec.

Peace negotiations between the British and Americans continued until November 30, 1782, and the Treaty of Paris was signed on September 3, 1783. The boundary line between the province of Quebec and the United States was defined in the treaty but differences in the interpretation of terms employed in the treaty text resulted in a series of disputes not finally settled until a half-century later.

When hostilities ceased, Loyalist refugees began to assemble in large numbers. In and near New York, under the supervision of Sir Guy Carleton, they swarmed into accommodation camps. During the open navigation season of 1783 fleets of transports sailed from New York. Some carried nearly 30,000 Loyalists to Nova Scotia, many of them to the boom city of Shelburne. Smaller numbers sought homes on the Island of St. John and on Cape Breton Island, but the largest contingent sailed for the mouth of the St. John River. There was a much smaller and more gradual trickle of such refugees into the province of Quebec. A goodly number penetrated into Upper Canada, along the St. Lawrence as far west as Cataraqui. This widespread and, in the case of the eastern provinces, large-scale influx of new settlers gave an impetus to organized surveying and mapping of the country unexampled in the history of this nation up to that time. The development brought about an upsurge of activity in these fields not matched in nature and scope until the introduction of the extensive surveys of the prairie West almost a century later.

Nova Scotia

The hardships experienced by Major Holland and his family in America in the 1770s were typical of those suffered by people in the thirteen colonies who cherished their British heritage and citizenship. The temper of the revolutionary times was harsh, however, and the bitter hostility encountered in their American neighborhoods by the Loyalists drove the latter in large numbers to seek a new land and a new life. It was natural that these United Empire Loyalists, as they came to be called, regarded Canada as their logical destination. Many were attracted to Nova Scotia where relatively little land settlement and development had been achieved (at least in that part which is now New Brunswick) since Sir William Alexander's abortive 17th century colonization project at Port Royal. Halifax and Lunenburg had been founded in 1749 and 1753 respectively and a number of farming and fishing communities, largely Scots and New Englanders, had come into existence from 1760 to 1780.

Seigniories represented the land-holding pattern in the St. Lawrence Basin from the earliest days of European settlement but the seigniorial system was not entirely unknown in other parts of Canada. Several seigniories had been established in Upper Canada in the early 18th century and by 1703 some fifty seigniories were to be found in what we now know as the Maritime provinces, exclusive of Newfoundland. Some of these holdings had never been effectively settled and had been abandoned. The seigniorial rights of Charles de la Tour, for example, comprised two seigniories in the Cape Sable region; also the seigniory of Annapolis and that of Minas. There was also the important seigniory of Chignecto and the tiny one at Cobequid. Between the years 1699 and 1703 the French government conducted a review and revision of seigniorial titles in Acadia, culminating in the royal decree of March 20, 1703.[3]

About 20 of the 50 aforementioned seigniories did not come under the 1703 decree. Those excepted lay, for the most part, along the St. Lawrence Gulf coast, extending from the Strait of Canso to Gaspé. The decree dealt mainly with seigniories situated along the St. John River.

Following the cession of Acadia to England under the Treaty of Utrecht (1713) it was not the policy to dispossess Acadians remaining in the region but it was felt at London that terms of land-holding might be made to accord with Anglo-Saxon usage, with unimproved lands considered as Crown Lands. But the new rulers of the territory never fully grasped the extent of French seigniorial land grants in Acadia.

Any serious study of Nova Scotia land settlement during the first half of the 18th century cannot be divorced from consideration of the timber-cutting policies of the British government in the province. The British Admiralty made certain that its vital requirements would prevail and so it was decreed that Nova Scotia lands would not be opened for settlement until a total of 200,000 acres of woodland suitable for the production of mast timber for the Royal Navy was first "marked out by Her Majesty's Surveyor General of the Woods in America in one or more parcels". The provision of such an immense acreage for this purpose was unique to Nova Scotia.

The earliest official reference to any proposed British survey operation along Nova Scotian coasts is a rather fragmentary one. It is found in a communication dated August 16, 1721, from Governor R. Philipps to the Board of Trade: "Government sloop arrived only three days ago. No time for survey of eastern coast this summer".[4] This message had reference to the *William Augustus* built in Boston earlier in 1721 as a survey vessel for use along the coasts and in the harbors of Nova Scotia. The sloop had been constructed on the advice of a naval captain, Thomas Durell. In subsequent seasons this survey was carried out under Capt. Durell who prepared maps and charts related to his examinations. In doing so he revealed special gifts as a cartographer. Two of his productions are still on record. In the Public Archives of Nova Scotia there is "A Draught of Torrington Harbour" (the earlier name for Halifax Harbor) on a scale of 3 miles to 2⅜ inches. This is regarded as the finest map of the port and of Bedford basin ever made up to the establishment of Halifax in 1749. Durell's "A Chart of the Sea Coast of Nova Scotia Accadia and Cape Breton . . . 1736" on a scale of 5 miles to 1¼ inches, is in the Colonial Office records, London, England. These surveys and resulting maps form a noteworthy link in the chain of developments culminating in the founding of Halifax and the beginning of British settlement in Nova Scotia.

Probably the first recorded grant of Nova Scotia land relates to the issue to a Major General Cosby, Lieutenant Governor of His Majesty's garrison at Annapolis Royal, of a plot of ground on Canso Island, an area of about an acre, granted on the basis of a yearly rental of two shillings and sixpence, payments beginning on August 24, 1722.

What may well constitute the earliest existing legal description of real property in any English-speaking part of Canada is to be found in the minutes of October 8, 1731, of His Majesty's Council of Nova Scotia: Governor Armstrong had advised the Council that Major Paul Mascarene had presented him with a petition for a "Plott of Ground Scituated W.B.N. ½ N. from the fort of Annapolis Royall Distance 371 Yards by 67 Perch Containing in the Whole Eight Acres and five Perch as *per* the Plan thereof Upon file lying Upon the N.N.E. Side of the Road going up the Cape Bounded on the WBN Side by the Whitehouse ffeild and on the ECS Side by Ground belonging to Anthony Bellivo . . ."[5]

On October 14, 1731, the Council provided for the publication of the Governor's order among inhabitants of the area and provided that "*Governor* Armstrong should Explain to the Deputys y^{t} part thereof Relating to their Employing the Kings Surveyor that none of them may be made to believe *that he is to do it for Nothing*". (author's italics) Apparently all Council members felt that in order to avoid vexatious legal actions over property boundaries as well as to better ascertain the boundaries of each man's property, the lands ought to be first surveyed in line with royal instructions.

The first casual indication of the presence of a Surveyor General in Nova Scotia is found in a letter dated August 4, 1738 from Governor Armstrong to Council Secretary Shirreff.[6] "This is therefore to Acquaint you that for the future You are not to make Out a Patent or any Other Survey or Estimation then made by the Surveyor Gen. Col. Dunbar or One of his Deputys . . ." This isolated reference probably relates rather to a military rank of those days than to any civil government official.

It should be noted that two years before the signing of the Treaty of Utrecht one Charles Morris was born in Boston (June 8, 1711), the child who was to become the first of a line of distinguished surveyors of that same name and the founder of a family dynasty of Nova Scotia surveyors general. Young Charles grew up on his father's farm near Hopkington, Massachusetts. In all probability Charles was trained in surveying under Governor William Shirley of that New England state. The history of Nova Scotia land surveys from 1749 to 1781 is to a large extent the story of the first Charles Morris.

On Governor Shirley's instructions Capt. Morris proceeded from Massachusetts to Nova Scotia in 1745 to undertake a survey of all that region with a view to providing information and guidance to the authorities on any proposal to populate the province with English settlers. This survey proved to be of the utmost value to the colony and to the Board of Trade and Plantations. Governor Shirley in writing to the Duke of Bedford, highly recommended Morris for further service in Nova Scotia. Doubtless this action led to the Bay of Fundy survey by Morris three years later. At the first siege of Louisbourg (1745) Morris served under Pepperrell as Captain of the Provincials. He narrowly escaped death when he and his troops were ambushed in 1747 at Grand Pré by the French.

In 1748 Capt. Charles Morris re-enters upon the stage of this narrative when on December 8 he was ordered by Governor Shirley of Massachusetts to take the sloop *Eagle* for a survey expedition into the Bay of Fundy. With Morris on this undertaking was John Gorham, later to play a significant role in the general development of Nova Scotia. After the expedition Morris submitted a comprehensive plan of his survey to the Governor who, in turn, transmitted it to the Board of Trade and Plantations in London.[7]

British efforts to bring about settlement of Acadia met with little success in the more than quarter-century following the Treaty of Utrecht. Not, in fact, until advertisements appeared in the English press in 1749 did the settlement situation improve. These advertisements held out "proper encouragement" to discharged army and navy veterans to emigrate to Nova Scotia. Parliament voted £40,000 in support of the movement and on May 9, 1749, the aristocrat Col. Edward Cornwallis was named Governor of Nova Scotia. With an advance party of settlers he arrived in Chebucto Bay, now Halifax harbor, in June, 1749. By July 1 some 2,500 more immigrants had arrived on 13 transports. On July 14 a civil government had been organized. Among the Governor's first councillors was Capt. John Gorham, fresh from the Bay of Fundy survey.

The new town of Halifax, named in honor of George Montagu, Earl of Halifax and president at that time of the Board of Trade and Plantations, was located on the west side of the harbor. The formidable task of fortifying the dominant hill, clearing the forest, and constructing dwellings was commenced. On August 8 a proclamation was issued calling a meeting of heads of families for the purpose of allotting farm land and town lots. The townsite was selected and laid out by Capt. Morris and John Bruce,

FIGURE 13. Founding of Halifax. Governor Cornwallis plans settlement's fortifications with John Bruce, engineer, following arrival on *Sphinx*, July, 1749.

a military engineer. On September 25, 1749, the first Charles Morris was made Surveyor General of the province.[8] In that same year one George Washington was commissioned a surveyor in Virginia and the year marked the birth in Winston, Durham, of Aaron Arrowsmith, who became the most famous map publisher of his time.

Land registry records of ancient vintage indicate that the peninsula on which most of Halifax is located was initially subdivided in eight parts and laid out in lots in 1749. The eight subdivisions were named Collier's, Foreman's, Ewer's, Galland's, Callendar's, Foreman's North, South Suburb and Fish Lots (on the North West Arm). The pattern consisted of blocks of lots, identified by letter and number. Cards were issued bearing these symbols and land ownership was determined by lottery. When drawn by a settler the card conveyed legal title to the holder of the lot indicated thereon.

The streets of original Halifax were made 55 feet wide and were not designed for vehicular traffic. In fact, at the time these streets were laid out sedan chairs were still in use. Vehicular traffic did not appear in Halifax until the end of the 18th century.

Newly-founded Halifax had become the site of the provincial capital, the transfer being made from Annapolis Royal in 1749. At that time the province consisted not only of the peninsula of Nova Scotia but also of what is now known as New Brunswick and Prince Edward Island but not Cape Breton Island. Not until 1759 was the peninsula part of the province divided into five counties, namely, Halifax, Annapolis, Kings, Cumberland and Lunenburg. With the establishment of Halifax as the seat of the provincial government the granting of lands began in earnest and reached a peak between 1759 and 1765. During that period at least each of 20 individuals received holdings of 100,000 acres or more. In 1759 alone some 1,200,000 acres of Nova Scotia lands were granted and in 1765 more than one-fifth of the total arable area of the province, or some 1,500,000 acres, was distributed. It should be noted that in that same year more than a million acres were granted in what is now New Brunswick.

By 1752 the population had grown to 4,000. That was the year in which Canada's first newspaper appeared. A plaque in Province House, Halifax, today proclaims that "nearby is the site of the first printing press in British North America, established in 1751 by Bartholomew Green. On it was printed on March 23, 1752, the first newspaper *The Halifax Gazette . . .*"

At this significant stage in Nova Scotia's growth the name of a pioneer surveyor and mapper comes into prominence. In 1733 Governor Armstrong had ordered George Mitchell "to survey the woods and lands lying on both sides of the Annapolis river from the Gutt upwards, duly distinguishing between . . . the cultivated and uncultivated parts."[9] As a result of this survey Mitchell produced a remarkable map of the Annapolis Basin and River. The map legend: "Surveyed in the year 1733, correction from other surveys-1753". The scale of this map is one inch equals one mile. The map is sufficiently accurate to enable identification to be made of the principal Acadian settlements of that time. The name of the surveyor is not inscribed on this map but it is without doubt the work of George Mitchell. However, as pointed out by W. F. Ganong, the eminent New Brunswick authority on early Canadian cartography, it is uncertain just how much of the map is his own work and how much belongs to the "other surveys" of 1753.

On October 2, 1758, the first Nova Scotian Assembly met, the first gathering of its kind in English Canada. As early as 1761 Acts were passed by this body involving services of surveyors. Examination of this legislation reveals that the term "surveyor" in those days had a much wider connotation than the modern word. There were "surveyors" of fish and of lumber as well as of highways and land. In 1761 an Act (ch. 14, George III) was passed concerning "the repair and mending of Highways, Roads, Bridges and Streets and for appointing Surveyors of Highways Within the Several Townships of the Province".

Chapter 2 of the statutes of 1765 provided for the *appointment* of Surveyors of Highways. A jury was to be summoned to view and lay out needed public highways, such highways not to be less than 100 feet wide. A 1762 Act (ch. 8, George III) dealt with the appointment of officers to survey barrels, staves, hoops and boards in connection with the exportation of fish. The materials were to be viewed, surveyed, measured and marked by these officers. It is clear that the term "surveyor" appearing in these laws, is not being used in the modern technical sense of the word.

During the years 1760 to 1765 an all-important movement of settlers into the Nova Scotian peninsula took place. This New England of pre-Loyalist immigration, as it is commonly known, exceeded in lasting influence within the province the Loyalist influx a score of years later. The New Englanders came with enthusiastic governmental blessing. Before the Seven Years' War ended the administration of Nova Scotia began to cast about for fruitful sources of suitable immigrants for large-scale settlement of the province. The dispersion of the Acadians had greatly sharpened the need for newcomers. New England was regarded as a most promising recruiting ground because the people there were accustomed to pioneer life. In addition, many of them knew Nova Scotia from first-hand experience and could more readily visualize conditions and possibilities.[10]

Hundreds of New England farmers and fishermen showed keen interest in coming to Nova Scotia but cannily obtained government guarantees of religious and civic freedoms before making their move. The first such settlers arrived in the spring of 1760.

For several years thereafter others followed in a steady stream, most from New England. Their roots grew deep in their new surroundings. Many of the communities they formed have continued in existence to the present day.

By this stage in provincial history the granting of land by townships had become accepted practice. Generally these townships consisted of 100,000 acres and were granted to settlers collectively. Following a survey of external lines of the township, government responsibility in the matter of land division ceased. These townships consisted of individual shares or rights, often representing 500 acres. But the actual division into lots was left to the settlers themselves, frequently operating through Proprietors' Committees for this purpose. But the size and nature of the lots differed with various townships. As a rule lots were reserved in townships for church and school purposes and for parade grounds to provide for militia training and displays. For any lot surveys, whether farm or town, the surveyor was responsible, not to the government, but to the township committee. For this reason plans and field notes of those early surveys were, more often than not, burned or lost.

In general, then, New Englanders replaced Acadians in the Annapolis Valley, Minas, Cobequid and Cumberland districts. Usually each settler received, in addition to his basic grant of land, a part of cleared upland and a woodlot. The marshlands of the Chignecto Isthmus received, in relation to its area, the smallest number of New England settlers. But New England fishermen, families from Cape Cod and Nantucket, settled in large numbers along the south and west coasts of Nova Scotia, in townships such as Yarmouth, Barrington, Liverpool and Chester.

People from the Old World also came during this period to make new homes in the province. Some one thousand Yorkshire immigrants came in eleven ships to settle in the Chignecto country. Some two hundred Highland Scots on the ship *Hector* landed at Pictou in September, 1773, the commencement of important Highland immigration to Nova Scotia, and especially to Cape Breton. Scotch-Irish people, some of them from New England, others straight from Ireland, settled in the townships of Truro, Onslow and New Dublin. All settlers in pre-Loyalist areas were Protestants. These settlements were separated from Halifax and from each other by dense forests. Communications were very poor although Halifax and Windsor were connected at that time by a road of sorts.

In 1765 an Act (ch. 1, George III) for the Choice of Town officers and the Regulating of Townships provided that "the original boundary lines of each and every township or district . . . shall be run betwixt township and township and marks renewed once in three years by the surveyors of lines and bounds appointed for respective townships" (section 3). Section 4 of the Act provided that each and every proprietor of lands "shall once in two years run the lines, make and keep up the boundaries of such lands by stones or other sufficient marks, on penalty of 20 shillings fine". In this section there is reference also to Fence Viewers, a term that appears in later legislation in other parts of Canada and pertaining to the task of maintaining property boundary lines in good repair. Also in this Act the various types of surveyors are listed for each township: 2 [land] surveyors; 4 surveyors of highways; 4 fence viewers; 4 surveyors of fish; and 4 surveyors of lumber and cordwood. Boundary lines in each township were to be run and marks of same renewed every three years, or two years in the case of privately owned land.

It is likely that in the drafting of these pioneer measures on surveying Charles Morris, Nova Scotia's first Surveyor General, was carefully consulted. A reliable and experienced surveyor he was, however, without any legal training. He is probably the only man ever to become a Chief Justice anywhere in Canada without having been a member of the bar. If such an achievement does not represent a fulsome tribute to the legal profession, neither is it any reflection on the versatility of a well-qualified surveyor.

Charles Morris, in 1752, was appointed a judge of the Inferior Court of Common Pleas in Halifax. It should be pointed out that a judgeship in those far-off days did not possess the elevated status it acquired much later. In relative prestige the position could best be compared to that of a present-day magistrate. On December 30, 1755, Judge Morris was appointed a member of the Executive Council of Nova Scotia. Then in order to fill a temporary gap in the succession of Chief Justices of the province he was named Acting Chief Justice for a period of two years, 1776 to 1778.

The place of Charles Morris and his direct descendants in the survey history of Nova Scotia is a unique one. For more than 100 years, with hardly a day's interruption, four Morrises held the post and title of Surveyor General of Nova Scotia. That distinction was never bestowed upon any other person in the history of the province as the title was abolished before the last member of the Morris dynasty passed from the scene. The second Charles Morris was born in New England on December 31, 1732. It is recorded that he was named Surveyor General of Nova Scotia the day of his father's death, so that there was no hiatus whatever in the succession. The day after the second Charles died (January 26, 1802) his son, Charles Morris the third succeeded him. He retained the office until some months before his death in 1831. On April 6, 1831, his commission was revoked and his son, John Spry Morris (born in 1795), was appointed Surveyor General the same day.[11] The post of Surveyor General of the province was merged with that of the Commissioner of Crown Lands in 1851. Actually, John Spry Morris had been Commissioner of Crown Lands (exclusive of Cape Breton) since 1827.

An interesting sidelight on the Morrises is that the second Charles, despite the fact that he was Surveyor General, became a candidate for election in Halifax in 1788 and won by a majority of 141 over his opponent, Mr. Sterns. But as a result of the bitter class feeling to which reference has already been made, a serious riot followed on the election result. The older settlers battled the recently-arrived Loyalists in a wild free-for-all and many persons suffered injury.

Another notable figure in the surveying and mapping story of early Nova Scotia was an Englishman, Capt. William Owen, R.N.* Capt. Owen accepted an invitation from Sir William Campbell to accompany him to Nova Scotia as secretary when Sir William was named Governor of that province in 1766. On May 29 of the following year he toured Cape Breton and St. John Islands with the Governor and in September, 1767, accompanied Sir Thomas Rich on a tour of the province, exploring lakes and streams of the Shubenacadie River system and the south shore of Minas Basin.[12]

In 1761 the British government, as has been noted, instituted a policy of conveying large grants of American colonial lands to retired army and naval officers as reward for their services and to aid in promoting settlement of the colonies. In the winter of 1766 Capt. Owen petitioned the government at Halifax for a grant "of land at Passamaquoddy" and this was granted on March 13, 1767, and included Passamaquoddy (Outer) Island in the Bay of Fundy. Capt. Owen lived at Campobello in the years 1770 and 1771 only, but he did bring English settlers to the island. A son, later to become Admiral Sir Edward W. C. Rich Owen, was born on Campobello Island on February 19, 1771. A second son, who became Admiral William Fitzwilliam Owen was to play a notable part in the marine surveys of the Great Lakes during the early years of the

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*Capt. Owen was a veteran of the Indian Campaign and had lost an arm at Madras.

19th century. Probably the greatest contribution made by Capt. Owen to the development of surveying in British North America was his custom of keeping a Journal of his explorations and travels, an account that never failed to stir the imagination and ambition of his son William during his boyhood days.

Another outstanding personality in 18th century Halifax was Sir John Wentworth (1737-1820) who made exciting history in many ways, not the least interesting being his dual accomplishment as Governor of New Hampshire and of Nova Scotia at different periods of his career. Sir John was the son of a wealthy merchant of Portsmouth, N.H. He was named Governor of the American colony on August 11, 1766, in succession to his uncle Benning Wentworth. At the same time he received a novel commission as Surveyor General of the King's Woods in all North America.* He took the latter assignment very seriously, landing at Charleston, South Carolina, in March, 1767, and travelling northward, registered his commission as special surveyor in each of the colonies, reaching New Hampshire in June. Like Samuel Holland, John Wentworth was a zealous Loyalist. Like Holland also he was treated very roughly by the revolutionists. His home was pillaged in 1775 and he was compelled to seek refuge in Boston. Eventually he left America, remaining in London until 1783 when he received a new and somewhat modified commission as Surveyor General of the King's Woods. On May 14, 1792, Wentworth was made Lieutenant Governor of Nova Scotia, and three years later was created a Baronet. A popular figure in Nova Scotia, his administration of its affairs was marked by energy and skill. He invited some criticism, however, by filling his council with his own close connections, but he was extremely loyal to anyone whom he regarded as competent and in whom he had become interested.[13]

As Loyalists continued in large numbers to pour into Nova Scotia from New York, the demands for surveys grew apace. Land allotment and land tenure procedures were formulated in great haste. In the development of land regulations during the early 1780s, in essence six documents were required in the rather involved process of obtaining a simple grant of land. In brief, the steps to be taken in this connection were as follows:

1. The prospective grantee petitioned the Governor for land, sometimes specifying the particular plot desired.
2. The Governor, sometimes after consulting his Executive Council, initialled the petition and sent a warrant or order to the Surveyor General to survey a certain tract of so many acres.
3. The Surveyor General, or more usually one of his deputies, having surveyed the same, returned a description of the land to the Governor and also sent a copy of the surveyor's report to the Surveyor General of the King's Woods to discover whether any or all of the land in question had been reserved for naval purposes.
4. The Surveyor General of the King's Woods issued a certificate which was sent with the warrant to survey and the surveyor's report to the Provincial Secretary's office where the actual grant was made out, signed by the Governor. Only then did the patient grantee acquire legal title to the land.

The documents involved, therefore, in this procedure included the petition, warrant to survey, surveyor's description, surveyor's report, surveyor's certificate and the draft of the grant itself. Today in the surviving records of the province it is not often that all of these papers are available as proof of legal title. Quite often the petition and the surveyor's report are missing. After 1785 the Attorney General of the province usually affixed his fiat on the back of the warrant to survey.

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*The official responsible for conserving woodlands to insure a reliable supply of masts for the Royal Navy.

Some 1,488,871 acres in all were escheated (forfeited) to the Crown in the right of the province between 1783 and 1788 and on these lands along with one million additional acres legally re-vested in the Crown, the Loyalists and disbanded army and navy veterans of the Revolutionary War were settled.

The Loyalists who, at the outset of the great movement, flooded into Canada were from many professions and trades including jurists, physicians, lawyers, surveyors, bakers, wine-merchants, wig-makers, snuff dealers, gunsmiths, silversmiths and barbers. There were ladies in silk and in homespun, the dignified and the flippant, the useful and the not so useful. But all demanded properly surveyed lots, and in a hurry. Winter would come all too soon and action from surveyors was expected within a month or two. Surveyors at their careful work were badgered by the impatient and occasionally assaulted by irate settlers. But it is likely that no surveyor suffered more at the hands of those he tried to benefit than Benjamin Marston (1730-92).[14]

Marston was a Tory and therefore a true Loyalist. He was born in Salem, Massachusetts in 1730 and educated at Harvard College, obtaining a degree in arts in 1749. It is not evident from any existing record that Marston was a fully trained surveyor. He may have picked up the fundamentals of surveying at Harvard and with a natural aptitude for the profession, could perform creditably in the role. In any event the first Charles Morris, Surveyor General of Nova Scotia at the time, engaged Marston as a Deputy Surveyor. In a diary faithfully kept by Marston the April 21, 1783, entry reads: "This day Charles Morris, Esq., engaged me to go to Port Roseway [Shelburne] to assist in laying out a new Township there". On that same day Governor John Parr of Nova Scotia approved the plan of the town. The streets were to be 50 feet wide and laid out at right angles.

The Loyalist descent on Shelburne, located near the southeast tip of the Nova Scotian peninsula, is one of the most impressive incidents in the long history of Canadian surveying and settlement. At the peak of the influx of Loyalists (1784) the population in this locality reached 12,000. This concentration of people made Shelburne not only one of the largest towns in British North America but was exceeded in total population only by Philadelphia, New York and Boston on this continent. Within one year after its founding Shelburne equalled in population Montreal, Quebec and Three Rivers combined and was considerably larger in that respect than a combination of Halifax, Saint John and Charlottetown. At one stage of its development Governor Parr seriously considered moving the seat of provincial government from Halifax to Shelburne. John Parr (1725-91) had become Governor of Nova Scotia in 1782, remaining in office until his death. He was the last to hold the title of Governor, as the title of the position was changed to Lieutenant Governor in 1786.

In the Shelburne area in 1783 hopes and enthusiasms as well as tensions ran high. On April 28 Marston, along with one William Morris, embarked for Port Roseway. Next day they called at Lunenburg for a set of surveying instruments. They arrived at their destination on May 2 and spent the following day exploring the vicinity. Marston found soil conditions better than he had anticipated.

The first rumblings of possible trouble in the embryo community are found expressed in Marston's diary entry of May 8: "The multitude object to the place which the Captain and Chief Men have chosen for the situation of the town because, they say, 'tis a rough, uneven piece of land . . ." Marston showed a rigid Tory attitude toward the tendency of the settlers to attack all their problems by committees. "This cursed republican, town-meeting spirit has been the ruin of us already . . . Mankind . . . oftentimes [possesses] too much liberty. Today surveyed the shore on the Eastern side of the N.E. harbour where it was determined to fix the town". On May 9 Marston's diary entry notes: "According to the determination of Thursday, laid out centre street of the new town and the people began very cheerfully to cut down the trees, a new employment to many of them".

The diary continues. May 14: "Ran one line today. People turning very indolent, some parties not at work until 11 o'clock". May 16: "This day began to mark out some blocks into house lots. People inclining to be mutinous". May 18: (Stephen Binney, custom collector, having joined Marston and Morris in their surveyors' tent) Marston comments: "He won't live long with us, our fare is too hard, our apparatus too indelicate and coarse". Saturday May 24: "Thursday last the people drew their town lots . . . Some grumble, some are pleased." May 29: "The idea of owning land is some how or other exceedingly agreeable to the human mind. Some whose lots have fallen to them in not so pleasant places are much out of temper, and some designing ones who have missed the advantageous situations, are likewise dissatisfied. Came home late in the afternoon, smutty and fatigued".

During May and June of 1783 William Morris directed survey operations. Later this function was transferred to Marston who by then had Messrs. Mason, Lyman and Tully as assistants. At this stage of proceedings Marston stood high in the esteem of Governor Parr. It was Parr who named the new settlement Shelburne in honor of Lord Shelburne, the cabinet minister at London directly responsible for the peace negotiations under which the 13 original American colonies obtained their independence. Naturally

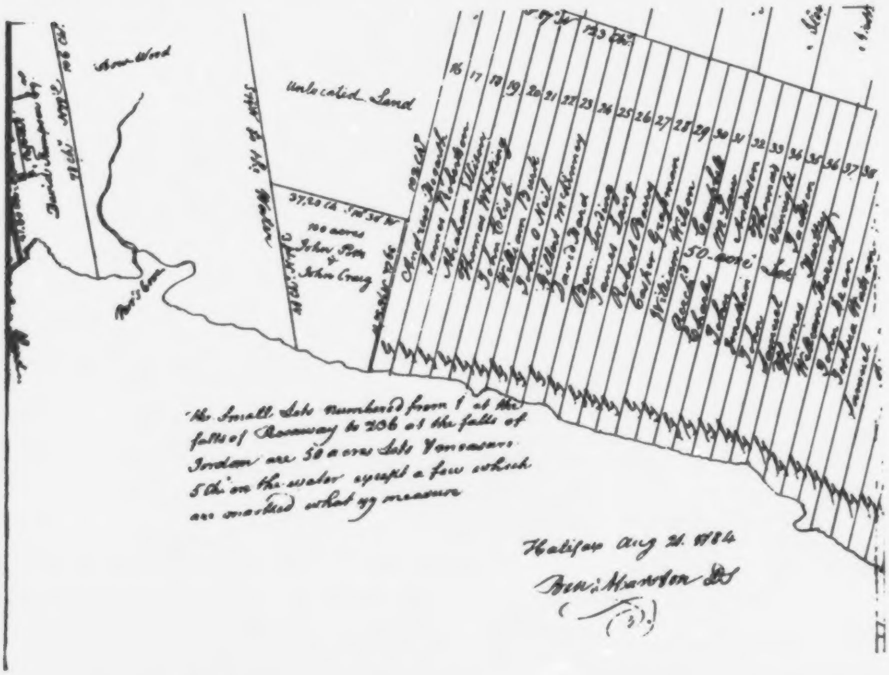
Unlocated Land
100 acres
John Pim
John Craig
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
The Small Lots numbered from 1 at the falls of Roseway to 206 at the falls of Jordan are 50 acre Lots ... 5 ch on the water except a few which are marked what ... measure
Halifax Aug 21. 1784
Benj. Marston DS

FIGURE 14. Part of Benjamin Marston survey of Shelburne Townsite, Nova Scotia, 1784.

enough not all the Loyalists shared the Governor's enthusiasm in this respect. Marston's diary resumes: Aug. 10: "Rec'd a packet from the Surveyor General's office, got two blank commissions for our Deputy Surveyors, the form of oath and a new plan of the town and its environs. The reserves in the new plan entirely deranges all that has yet been done towards settling persons in the farming line . . ."

Entries in Marston's diary up to the end of 1783 reveal increasing difficulties of surveyors and others engaged in settlement activities. For one thing the number of people who actually came to Shelburne greatly exceeded the most optimistic expectations of Nova Scotian authorities. As new arrivals increased the first modest town plans had to be enlarged. The most undesirable elements were among the last to arrive from the States and these drove Marston to complain in his diary that "These people are the very worst we have had yet; they murmer and grumble because they can't get located as advantageously as those who have been working hard these four months".

The spring months of 1784 brought a lively resumption of surveys, including the environs of Shelburne. May 1: "In the woods till 4 p.m. running the base lines for lots to be laid out". July 26: "Great riot today. The disbanded soldiers have risen against the Free negroes to drive them out of Town because they labour cheaper than they—the soldiers". July 27: "Riot continues . . . This morning I went over to the Barracks by the advice of my friends who find I am threatened by the Rioters and in the afternoon took passage to Halifax . . . arriving on 29th. August 4: "If I had been found, I . . . should have been . . . hung, from all I have heard".

August 18: "A ship from England, by which we learn this Province is to be divided, and a new government erected on the western side of the Bay of Fundy by the name of New Brunswick. If I can get some employment in the new Province, I shall choose my residence there . . ." August 31: "The Governor [Parr] returned from Shelburne, where he has been to settle the disturbances which have arisen. To answer some purpose with his Dear Shelburnites he has been pleased to throw a great deal of blame on my conduct". Sept. 7: "Presented a memorial to Governor Parr this day and date requesting a publick inquiry to be made into my conduct while Chief Surveyor at Shelburne. He says only in general that every body accuses me of the most corrupt partial conduct while in my office of Chief Surveyor".

Actually Benjamin Marston had many friends and sympathizers at Shelburne but the Governor's mind was firmly made up and he reported adversely to Lord Sydney concerning Marston's conduct. Governor Parr, in all likelihood, was over-hasty in passing judgment on Marston who, whatever his faults, was not self-seeking. He had left Shelburne, as he had come to it, a poor man. The letter to Lord Sydney resulted in his dismissal from the public service. Marston could be excused for feeling that this strong action was based more upon motives of expediency than on principles of justice.

Despite considerable social unrest, development of the settlement at Shelburne continued to be rapid. The first location of people on town lots occurred on May 23, 1783. By the following February some 1,130 houses had been built. By the autumn of 1784 the total number of house, store and wharf lots exceeded 3,000. In addition, 800 county lots of from 500 to 750 acres each had been occupied. Fortunes were recklessly spent on extravagant structures. The land surrounding the townsite was not particularly favorable to cultivation. In any case most of the newcomers were quite unfit for farming or fishing. In the space of two years it is estimated that upwards of £500,000 had been poured into this unpromising community venture.[15] As the hard realities of life in that locality gradually replaced the rosy dreams of the town's founders, its people began drifting away to other parts of Canada, leaving behind them a ghost town of crumbling homes, weed-infested streets and a depressing aura of decay and desolation. Today's Shelburne, a solidly based, attractive community of modest proportions, is in marked contrast to the almost completely abandoned town of the waning years of the 18th century.

The Shelburne surveying and settlement project must be considered as a special case. It had a spectacular rise and fall. But for the most part Loyalists settled peacefully and permanently in Annapolis, Digby, Granville, Guysborough, Cumberland and other districts in the province. The need for establishing, on an emergency basis, suitable townsites for thousands of newcomers, provided Nova Scotians with new insights in regard to the problems and responsibilities of provincial surveyors. In 1793 (ch. 8, George III) the Council and Assembly passed "an Act to enable the Deputy Surveyors of this Province, to administer an Oath or Affirmation, if Quakers, to such Persons as may be employed under them, as Chain Bearers in Measuring Lands". This legislation provided that where there was no Justice of the Peace within two miles of the place where the survey was to be made, the land surveyor was authorized to swear in chain bearers.

In the previous year Governor Wentworth, through the Surveyor General, the second Charles Morris, issued interesting instructions to one M. Archibald, a Deputy Surveyor, ordering him to "proceed with two or three active men, from the Head of the Musquedoboit River, to the East River of Pictou, and Blaze the Trees all the Way, where it may be proper for the Road to pass". The importance of opening up this highway from Halifax to Pictou was strongly emphasized in the communication.[16]

Not a great deal is known about early survey methods in Nova Scotia but it is generally accepted that practically all such land surveys were accomplished by elderly seamen using marine compasses. Often property boundaries were described in field notes in marine terminology. Only occasionally, it seems, were pioneer Nova Scotia land measurers properly trained in surveying.

Entries in the Journal of Valentine Gillis during the course of his surveys for the Shubenacadie Canal System, 1814-15, vividly delineate in laconic terms some of the rigors of surveying in those rugged times:

"Monday, July 25, 1814. Began with Circumferentor subdivided and a statute four pole chain at Ervines Bridge. . . .

"Monday, February 20, 1815. Continued the survey of Lake William. From this proceeded to Cormers House on side of Lake having walked twenty miles and being much fatigued expected the consolation of a good fire and a good soft plank to stretch upon, but how great our disappointment and surprise on entering the Hut I found the Old Man John Shane who had been left to take care of the place, dead. He was frozen to death I suppose three weeks before that. . . . There was no alternative so I took my abode this night with John and early next morning continued the survey. . . .

"Thursday, July 11, 1815. This afternoon renewed the survey after one of the most dreadfull Thunder Showers I have ever experienced in my life. The hand of heaven was truly visible in protecting us, the trees over our heads was struck with lightning, we strongly smelled the sulphur and had we reached the shore one minute sooner, we must have been struck also as the lightning entered the ground at our landing place".

Among the Loyalists who came to the Halifax area in 1783 were two very close friends, the Congregationalist ministers, Reverend Theophilus (Theo) Chamberlain (1737-1824) and Reverend Titus Smith (1734-1807). Both had been students at Yale University, graduating within a year of each other. Chamberlain received a commission in the British Army and on the evacuation of New York was given a special commission by Sir Guy Carleton to take a group of Loyalists to Halifax. Smith accompanied him. Chamberlain was appointed by the second Charles Morris as Deputy Land Surveyor and instructed to lay out Preston township near where Dartmouth now stands. Chamberlain, a warm friend of Sir John Wentworth, received a grant of 1,000 acres in the area, and Smith, 500 acres. Chamberlain took part in occasional surveys. He had several sons, one of whom became a Deputy Surveyor.

Reverend Titus Smith was more the philosopher than a man of affairs in the country of his adoption. During the early days of the American Revolution his knowledge of chemistry was brought to the attention of George Washington who asked him to make gunpowder for the Continental Army. But he refused, being opposed to war on principle. In Nova Scotia he, like Chamberlain, was befriended by Sir John Wentworth, who presented him with a complete set of botanical works of Linnaeus. These books greatly influenced the career of Titus Smith Jr.

Titus Smith Jr. was born at Granby, Massachusetts, on September 4, 1768, and lived with his father at Preston following his arrival in Nova Scotia at the age of 15. When not occupied in clearing land, constructing stone walls, and cultivating the farm, young Titus read the classics and studied botany. In the last decade of the 18th century he became a land surveyor, a profession he practised from time to time thereafter. Basically he was a farmer by occupation, a surveyor by avocation, a scientist, philosopher and writer for recreation.[17] As a skilful practitioner of surveying and map making he could also be described as a geographer.

As the 19th century dawned, the government of Nova Scotia found it needed urgently a good map as well as reliable information of the then largely unknown interior of the province. This interior wilderness, although travelled to some extent by hunters, trappers and timber-cutters, was the subject of conflicting and none too reliable reports. The sea and the forest provided the main sources of livelihood for new settlers. Industries were needed to develop these natural resources. Thus in 1801 the provincial government asked Titus Smith Jr. to make a tour of Nova Scotia to discover such places "as are best calculated for producing hemp and furnishing other naval stores, to report on the quality of the land and character of the timber, especially that suitable for masts, and to establish the quantity of acres which could be rendered fit for cultivation". In effect what was requested was a land-use and natural resources survey without the benefit of any of the modern equipment and methodology we take for granted in the mid-twentieth century, or even of a moderately good base map. For his efforts Titus Smith was to be paid at the princely rate of 11 shillings and sixpence, Halifax currency, or about $2.35 per day.

Titus Smith spent more than 150 days in the woods and more than 200 days away from his base of operations during the two field seasons of 1801 and 1802. He made the entire tour afoot, equipped with brief instructions, a compass, a rough sort of map and what he could carry to maintain himself throughout the journey over some of the most challenging wilderness areas in North America. His Journal of Survey and accompanying map are in the Public Archives of Nova Scotia in Halifax. The map, produced on a scale of 8 miles to an inch, he conveyed to the Governor of the province in his report. It remained the only reliable general map of Nova Scotia until 1835. In 1796, Titus Smith moved from Preston to Dutch Village, a suburb of Halifax. In subsequent years he became widely known as the "Dutch Village Philosopher". He lived for another half century in these surroundings and became an honored, respected figure in the colony. He gave evidence before Lord Durham's famous commission at Quebec in 1838. In addition to service as Secretary of the General Board of Agriculture in Nova Scotia, he wrote a weekly column for the *Acadian Recorder* over many years. He lectured and published learned papers on a wide variety of scientific subjects and became an authority on fisheries.

All things considered Titus Smith Jr. was an eminent surveyor, a wise observer of nature and a distinguished geographer of his times. But the work by which he is best remembered is his handwritten "Survey of the Eastern and Northern Parts of the Province in the Years 1801 and 1802 With General Observations thereon. Also a Survey of the lands between Sackville (Bedford) and Shubenacadie And Observations on the Western Parts of the Province with a list of trees, shrubs, grasses and plants. And Observations on the nature and uses of the trees". (Public Archives, N.S. Vol. 380)

In his physically active years, hardship was a constant companion of Titus Smith. His work as a surveyor often led him, for instance, into marshy land and it is said that whenever he obtained new boots he immediately bored gimlet holes into the soles in order to let out water that would seep in. In 1832 he surveyed and marked the then newly constituted boundary between the city of Halifax and the rest of the county, a straight line from the North West Arm to a brook at Fairview near Bedford Basin. He set up three survey monuments to establish the line. The last of these monuments was removed about 1914 to make way for a new railway line.

Not far from Dutch Village and near the suburb of Fairview is a simple memorial stone erected by friends of this grand old man of Nova Scotian surveying and mapping. The stone bears the brief and simple legend: "Titus Smith, died January 4, 1850, age 81".

There is no record of any protest by Titus Smith Jr. over the unimpressive rate of pay he received (for) surveying assignments but there were others in those times who were quite agitated over an issue of this nature when it affected them directly. While Surveyor General of Nova Scotia (1831-51) John Spry Morris wrote some lively letters to his superiors over what he considered to be grievously inadequate compensation for his combined duties as Commissioner of Crown Lands and as Surveyor General of the province. On April 2, 1847, he submitted a petition in regard to his salary to Earl Grey, Secretary of State for the Colonies.[18]

In the petition he observed that he had been appointed Commissioner of Crown Lands on May 4, 1827, and Surveyor General on April 6, 1831. He claimed that he was justly entitled to receive out of the proceeds of Crown Lands transactions an annual salary of £500 with an additional five per cent of surplus monies paid by him into the annual revenue of the province to an additional amount of £500 sterling. As his salary as Surveyor General was £150 together with certain fees imposed on all land grants (the latter amounts forming the chief source of his income) he was experiencing reasonable prosperity but in 1834, to his dismay, these fees were abolished. Surveyor General Morris complained that as he "was entitled to receive annually the sum of £1,150 from the united offices of Commissioner of Crown Lands and Surveyor General, yet it happened in consequence of the Sales of Land being of small extent, comparatively, that the full amounts to which he was entitled were never realized by him, but the average for the last two years has reached (to) £720 sterling".

The petition proceeded to point out that a recent provincial act provided that the Department on Cape Breton Island be abolished and its duties attached to the Halifax office. It also proposed to fix his emoluments at £400 . . . "a scale far below" that to which he had hitherto been accustomed to receive. He protested the unfairness of such a marked reduction "in view of his increased responsibilities and the impermanency of his salary".

Whatever hopes John Spry Morris nurtured, after the presentation of his petition, were rudely dashed by Bill No. 7 passed by the provincial legislature on November 29, 1851. This Act, relating to the Crown Lands Department, provided that the Surveyor General and Commissioner of Crown Lands shall hereafter be styled "Commissioner of Crown Lands". This marked the disappearance of the title of Surveyor General of Nova Scotia, never to be restored. The measure also provided that "it shall be the duty of the commissioner of crown lands to cause a survey to be made of all the crown lands within ten miles on each side of any line of railroad . . . such lands to be laid off in lots of one hundred acres each . . . and to prepare and cause to be lithographed, plans or maps of such lands, with the lots numbered, and the course of the railroad or of any streams or public roads running through same [to be marked thereon]". In so far as it dealt with surveys this legislation foreshadowed the establishment of a notorious railway belt on the other side of the continent in a province yet to be created. The British Columbia Railway Belt, more than a century later, bedevilled the politics and impeded the economic development of that part of Canada over a considerable period.

On December 9, 1851, Joseph Howe, the Provincial Secretary, wrote to John Spry Morris, calling attention to the passage of Bill No. 7, "a copy of which is enclosed for your information". Mr. Howe was a shade cruel in his accompanying comments. "The main object of the Legislature in passing this law", he stated, "was to throw on the Commissioner of Crown Lands and his deputies the duty and undivided responsibility of managing and disposing of the Crown Estate with a view to avoiding the uncertainty and delay which have hitherto characterized this branch of Provincial administration. With this in view, chapter 28 of the Revised Statutes has been repealed and the County Land Boards abolished".[19]

John Spry Morris replied to Howe with an air of injured pride. He took pains to explain, in a letter dated December 18, 1851, the difficulties that had prevented prompt performance of those heavy additional duties imposed upon him. "When a few years ago", he pointed out, "the duty of preparing grants of land fell on the Crown Land Office as well as the functions of the Department in Cape Breton, it is not surprising that business fell in arrears. It is not as if the whole Province had been correctly surveyed in lots, and plans of them were to be had. The fact is that from its first settlement there has been no regular, connected system of surveys, the lands generally were of so little value that the applicants hesitated about paying for the survey of them—and in order to induce them [to do so] they were allowed to be laid out in every variety of form, no fund being provided by the Government for this purpose.

"Another very serious evil in the Province is the constant intrusion upon the public lands by squatters who enter into possession and extend their improvements without any surveys being made. The consequences are in later years when circumstances oblige occupants to obtain titles, [we] have found it extremely difficult to lay out their lands in any regular form and until this [squatting] practice is put down, it will be almost impossible to prevent delay". John Spry Morris, in this melancholy recital, makes no protest over the disappearance of the title of Surveyor General!

In what turned out to be a valedictory of his career, John Spry Morris in concluding a Report dated February 15, 1853, wrote, "I have now been more than 35 years in this Department, of which period nearly 26 have been as head of it. During this long period I have always endeavored to discharge its onerous duties to the best of my ability, without reference to parties—and if circumstances should induce me to retire, shall carry with me the firm conviction that no person can justly accuse me of having done him wrong".

On September 19, 1853, he applied for leave of absence on the grounds of ill-health. On April 15, 1854, James B. Uniacke was named Commissioner of Crown Lands. John Spry Morris had been deposed. But he was not entirely crushed by this development and lived on until 1881, to the ripe old age of 86.

So much for quarrels on higher levels over rates of remuneration. It is interesting to look also at rates of pay received by those at the bottom of the survey staff structure in those days. Whitman Freeman, for example, was a very active surveyor in Nova Scotia in the early years of the 19th century. Some conception of the rates paid for survey work may be gleaned from a sample statement submitted by him on November 20, 1824, to the Surveyor General, the third Charles Morris. "For my time and Service . . . in surveying the Division Line of Queens and Shelburne Countys and part of the Rear Line of Lunenburg County . . . Surveyed between August 20 and November 5, 1824 . . .

"To hire of two Chainmen, one axeman and one Flag Bearer employed in the foregoing service, each 38 days at 4 shillings each per day . . . £30 8s.

"For Chopping and clearing the whole of the Dividing Line of Queens and Shelburne Countys four ft. wide distinctly marking the mile and half-mile posts (according to Instructions) 34 miles at 23 shillings 5 pence per mile . . . £39 16s. 2d.

"For my time and Service in the above Survey
38 days at 15s. per day . . . £28 10s. "

(Endorsed) "I do certify that the preceding account . . . appears reasonable, considering the nature of the Work thro a Wilderness remote from Settlements and intersected by Lake, Ponds, thick woods and other Obstructions and that all the persons employed found their own Provisions at their own expense . . ."

(Sgd.) Chas. Morris Surveyor General
Halifax, Dec. 7, 1824.

Prince Edward Island

In 1719 the first European colonists arrived on what is now known as Prince Edward Island, a land the Indians called "Abegweit" which has been translated "Cradled on the Waves". Two Normandy fishermen, Matthew Turin and Francis Douville, and their families, settled at East Point and St. Peters respectively. By the end of the 1720 summer season 17 families, or a total of 135 people, made their homes on the island. Eight years later there was a considerable influx of Acadians. By the time of the cession of the island to England in 1763 about 4,000 men, women and children inhabited the districts of Malpeque, Tracadie, Rustico and Souris.

Isle St. Jean, as it came to be known to the French, first fell into the hands of the English after the successful siege of Louisbourg in 1745 by the New Englanders. However, like Louisbourg, the island was restored to France by the Treaty of Aix-la-Chapelle, 1748. In the years immediately following the restoration some highly ambitious plans were made by the French to fortify the island but actual construction fell far short of official intentions. Col. Franquet, an officer of the engineers sent initially to help construct the fortifications at Louisbourg, visited Isle St. Jean and in connection with his 1751 report on its defences, drew a plan of Port la Joye (Charlottetown) and a copy of this map is in the Public Archives of Canada. Apart from his purely military activities Col. Franquet, with the trained eye of a surveyor, carefully noted and reported upon the appearance of the countryside, its products and potentialities as well as on the condition of the settlers themselves.

On returning to Port la Joye from a visit to St. Peters during that same year Col. Franquet found the French frigate *Gracienne* anchored at least a league outside the harbor. Her commander, fearful of grounding his vessel, was reluctant to enter the more sheltered but unknown waters. Col. Franquet accordingly arranged with the commander, Lieut. de Tourin, to sound the bay and prepare a chart of a safe course into the harbor. This is probably the first hydrographic chart made of this area.[21]

Following the signing of the 1748 treaty a fair number of Acadians came to the island. The exacting task of receiving the newcomers and assisting in their settlement fell upon Capt. Denis de Bonaventure. Letters from the captain to his superiors contain repeated appeals for a land surveyor, since the haphazard allotment of lands to settlers was creating distress and some strife. Apparently the island colony was without a competent surveyor and none was forthcoming from Isle Royale. Capt. de Bonaventure was supported in 1751 by Col. Franquet who recommended that the grievances of the inhabitants could be best dealt with by sending to them "an expert surveyor to settle land disputes here once and for all".

On Franquet's return to Louisbourg, Comte de Raymond was persuaded to visit the island. His visit instilled a general feeling of confidence among the settlers and he put an early end to boundary disputes by despatching surveyors to establish satisfactory property lines.

When Louisbourg fell in 1758 for the last time, Isle St. Jean was included in the terms of capitulation. Col. Lord Rollo and two companies of the 60th Regiment were sent by General Amherst to take formal possession of the island. This force arrived at Port la Joye on August 17, 1758. The nature and prospect of the land they found is well described by Capt. Holland in his reports connected with the 1764-65 surveys he supervised. Writing from his temporary residence at Observation Cove on October 5, 1765, Holland states: "Here is quick and frequent changes of weather, as rain, snow, hail and hard frosts succeeded each other in a very small space of time". Again later, in a letter dated August 19, 1766, Holland comments: "The soil on the south side of the island is a reddish clay, although in many places it is sandy, particularly on the north coast. . . . The Mountain Shrub and Maidenhair are also pretty common, of whose leaves and berries the Acadian settlers frequently make a kind of tea. The ground in general is covered with strawberries and cranberries. . . . In those places that have been settled and are still tolerably cleared, is very good grass but a great part of the island, formerly cleared, is so overgrown with brush . . . that it would be extremely difficult to make it fit for the plough. . . ."

In his October 5, 1765, report dealing with surveying activities Capt. Holland is at pains to explain that "the respective divisions of the island are, as near as possible, agreeably to my instructions. The divisions of the counties, parishes and townships, bounded by the magnetic north and south, or east and west lines, being the most easy way of running the lines for the survey is that which will be employed on this service, the natural situation of the island having favoured this method. It is not possible to divide the counties or parishes into more equal parts as the lines would otherwise have been too much confounded and confused . . . it has also been observed in dividing the townships to give them a share of what natural advantages the place afforded. The two lots that could not be brought into any township are left undetermined. There are 520 acres reserved for the first lot. . . . The scale proposed to work with I was obliged to alter to that of 4,000 feet to the yard, as we found that (to be) sufficiently large and impressive . . . but should any part be required to be of a still larger scale it shall be done whenever ordered — throughout the whole survey has been observed the greatest exactness; and all rivers and creeks are surveyed as far as a boat or canoe could go, or the chainmen penetrate, but sometimes we were compelled to stop by inaccessible woods and swamps. . .".

Holland, in his reports, remarked favorably on the location of Port la Joye as being one of the best parts of the island for the establishment of a capital. In connection with his field work Holland received in 1766 several letters from important sources commending him. Secretary Pownal wrote on May 19: "I am happy in obeying the commands of my Lords Commissioners of Trade and Plantations to signify unto you their entire approbation of your conduct in the execution of the instructions you have received for the surveys of the Island of St. John, and of your diligence and despatch in the completion of this useful and laborious work". A letter in complimentary terms was also received that spring from one Richard Cumberland to whom Holland replied on August 19: "I can assure you it revived my spirits and gave me new strength to endure the fatigue I at this time underwent, as it was the first news of the arrival of my plans and therefore made me climb the rocks and wade the waters without thinking of dangers or weariness".[22]

As Holland's reports indicated, the Lords Commissioners of Trade and Plantations had ordered (on March 13, 1764) a survey and division of the island into counties, each as nearly as possible to contain 500,000 acres. The counties, in turn, were to contain parishes of 100,000 acres each. The parishes were to consist of townships of 20,000 acres each. In each county sufficient land was to be set apart for a townsite, with a proper location in that townsite of a church and a glebe for its minister.

It should be borne in mind that on October 7, 1763, by Royal Proclamation the Islands of St. John and Cape Breton were annexed to Nova Scotia. So far as St. John Island is concerned this condition existed for only six years. In 1769 the island was detached and despite its tiny population, was constituted a new province with a government established by authority of letters patent. This separation from Nova Scotia was one of the two main features of British imperial policy towards the island. The other feature was the decision in 1767 when the Lords of Trade and Plantations announced that 64 out of a total of 67 lots of 20,000 acres each would be made available to a number of favored applicants by lottery. Those successful in drawing one of the island lots would be expected, in return for the land, to encourage fisheries, pay a small annual quit-rent within five years, settle the land within ten years with at least one European Protestant to every 200 acres. In a single day of lottery, therefore, there was fastened upon this attractive island province a scandalous "absentee proprietorship" system of land tenure. This unfortunate imposition dwarfed the island's growth for a century and stirred up continuous friction and discord among its people until its abolition in 1877. Samuel Holland, for his services as Surveyor General was granted Lot 28. As a landlord he lived up to his responsibilities and settled a band of English farmers and disbanded soldiers on his property.

In May, 1768, Governor Michael Francklin of Nova Scotia took steps on instructions from Lord Hillsborough, Secretary of State in London, to have the sites of towns on the Island of St. John laid out. He directed the first Charles Morris, Surveyor General of Nova Scotia, and an assistant surveyor Isaac Deschamps, to proceed to the island to supervise the formidable task. The officer commanding at Fort Amherst, across the harbor from Charlottetown, was instructed to aid the surveyors by supplying troops. Morris proceeded to select the present site of Charlottetown for the principal town of the province and laid out the town plot and individual lots. Georgetown, designated as the capital of King's County, was surveyed at about the same time as Charlottetown and on the same general plan, with all streets intersecting at right angles.

In a book published in England in 1806[23] the following description is given of the street system of the island's new capital: "the streets are laid out at right angles, those running from the river are 100 feet in breadth, the cross streets were originally laid out at 80 feet but have since been reduced to 40 feet in breadth. The building lots are 80 feet in front by 160 in depth. There is a common of 100 acres adjoining the town and with every building lot is granted a pasture lot of 12 acres".

Governor Francklin was happy to report to Lord Hillsborough on July 31, 1768, that progress was being made on the island surveys. He was satisfied that he was carrying out His Lordship's instructions as he understood them. After indicating the nature and scope of Surveyor General Morris's work at Charlottetown the Governor stated, "All officers of the (provincial) government have been hutted on the spot and are now building a little house, marked on the plan, to contain them during the winter. Some of the streets are opened, which will be attended with some expense to the government but it cannot be avoided and some few house lots have been taken up . . . Mr. Morris, by this time, has completed the laying out of the town for George Town whence he will proceed to Prince Town to do the same, in each of which an overseer will be left to execute any orders that may be given . . .".

But all was not clear sailing. Governor Francklin, in his administrative zeal, had incurred expenses in this survey project that had not been contemplated by Downing Street. Chilly disapproval was expressed in official terms and Governor William Campbell on his arrival in Halifax ordered the work so enthusiastically instigated and carried on by his Lieutenant Governor to be discontinued.

When the island became a separate province Walter Patterson, then a resident of England and part owner of Lot 19, was named its first Governor. He arrived at Charlottetown, the new name for Port la Joye, on August 30, 1770. Governor Patterson, whatever his faults, had energy and a clear appreciation of the value of surveys. It was not long before he had secured the services of one of Holland's pioneer surveyors, Charles Blaskowitz, to lay out a road from the capital to Prince Town. In his report to Lord Hillsborough in July, 1771, the Governor stated that he had "ventured, at my own risk, to have a road laid out from Charlottetown to Prince Town and although the surveyor avoids, by my instructions, all swamps, difficult rivers and steep hills, the road as measured was only ¾ mile more than if on a straight line, and it is only 33 miles (in all)". He gave as a reason for employing Blaskowitz that the latter had been wintering on the island and as he had been detained there by the late spring, he was induced to undertake the work on much easier terms than otherwise would have been the case.

In the same report the Governor explained the significance of changes he had made in the town plan as laid down by Mr. Morris. "I have taken the liberty to alter the plan of this town (along lines) I think best calculated for a northern climate, as every house will have a southern aspect, there being but one row of houses on each range, by which means likewise there will be a communication from every backyard into the street, which I look upon as a great convenience".

"I have enlarged the town lots by adding 24 feet in front and 20 feet in depth each . . . I have doubled the quantity of land in each pasture lot, as will appear by the plan. They were in the original only six acres each; besides which there is a large common left for the purpose of extending the town whenever that is necessary". The accompanying map shows the area of the entire development as 7,300 acres with 270 acres for the central town and 565 acres for the common.

A second road was undertaken "to connect George Town with the capital". The Governor lost little time in convening his Council and among those summoned to its first session was the surveyor Thomas Wright. Governor Patterson approached Wright to become Surveyor General of the province on the condition, however, that he become a full-time resident of the island. The condition was accepted and Wright continued to occupy this responsible position for more than 40 years until his death in 1812.

But the surveying activities of Thomas Wright were not, by any means, confined to the island province. In 1772 he conducted an important survey of New Brunswick coastal areas. In the words of the cartouche of the resulting map: "This survey was made agreeably to the Orders and Instructions of the Right Honourable the Lords Commissioners of Trade and Plantations to Samuel Holland, Esq., Surveyor General of Lands for the Northern District of North America. By his Deputy, Mr. Thomas Wright". This survey and map undoubtedly served as a reliable basis for the subsequent work of DesBarres in the same area.

After launching the new province on its career, Governor Patterson cast about for fresh opportunities to improve the condition of the people on the island. He had been shocked on his arrival to find that there were only five proprietors and 150 families on the allotments. But this was symptomatic of a condition destined to continue for many years. Most of the proprietors remained in England, indifferent to their holdings and making no attempts to obtain settlers, as they had promised to do. In 1773 the first island Assembly met, members numbering 18 in all. The one and only item on the agenda was that of land tenure policy. The Governor, unaware of the obstacles he would encounter, was eager to bring about reforms. When he discovered what little headway he could make on the island with his aims he visited England in 1775 and was successful there in having the island placed on the same constitutional basis as the other British North American colonies. Unfortunately, during his absence the province was raided by American privateers, frustrated in their efforts to engage British vessels in the Gulf of St. Lawrence as part of their Revolutionary War campaign.

Phillips Calbeck, senior member of the Governor's Council was interim administrator of the island government during the Governor's absence. The privateers, ordered to intercept two British brigantines carrying supplies and ammunition to Quebec, decided to raid Charlottetown. At the time the island capital was a totally unprotected village. After plundering the place and terrorizing the inhabitants the Americans, in returning to their ships, took Mr. Calbeck into custody and later made Surveyor General Wright also a prisoner "laughing" so one observer relates, "at the tears of his wife and sister, mocking them in their grief". The prisoners were conveyed to American headquarters located just east of Cambridge, Massachusetts. George Washington, on learning of the raid, was highly indignant. He soon made it clear to the American commanders of the raid, Nicholson Broughton and John Selman, that they had acted in a manner totally unauthorized by any orders they had received. The two officers were relieved of their commands. The prisoners were tendered the personal apologies of General Washington, released from custody and most kindly treated. All seized property was returned to them. "The plague, trouble and vexation I have had with the crews of all (our) armed vessels," George Washington remarks in a letter to the President of the Congress describing the incident, "are inexpressible. I do believe there is not on earth a more disorderly set".[24]

In 1784, as part of the great exodus from New York, some 600 Loyalists came to the Island of St. John. Their arrival served to intensify the need for a better land tenure policy on the island. After several futile attempts to persuade the Assembly to approve forfeitures of neglected lands, Governor Patterson finally obtained its approval to escheat 9 full lots and 5 half-lots. Even this partial measure of success was snatched from his hands when this action was disallowed by the British Government. The following year Governor Patterson was recalled. Actually, during the winter of 1786-87 the island experienced the luxury of two governors. General Edmund Fanning, nominated to be Patterson's successor, made his appearance but Patterson was loathe to believe that his recall was genuine, and lingered on hopefully. In the spring of 1787 Whitehall made the situation abundantly clear and Patterson departed post-haste for England.

Land tenure policy under the new governor continued to be a source of bitter public controversy. During Governor Fanning's administration the Assembly passed a measure requesting the government to confirm the Loyalists in the possession of their lands. The government, however, evaded action on the legislation and kept postponing confirmation of titles.

In 1799 the name "Prince Edward Island" officially replaced "Island of St. John", an action honoring the Duke of Kent, father of Queen Victoria. By the following year the population of the island stood at about 5,000, of whom some 300 lived in Charlottetown, named after Queen Charlotte. The early years of the 19th century saw the arrival on the island of some 800 Scottish settlers under the sponsorship of Lord Selkirk. These highlanders, for the most part, settled near present-day Eldon.

In 1805 Colonel J. F. W. DesBarres, the eminent marine surveyor, at the age of 84, replaced Edmund Fanning as Governor of Prince Edward Island. DesBarres, in a series of provokingly slow promotions, had been raised to the rank of major in 1783, lieutenant-colonel in 1794 and full colonel in 1798. He had been appointed Lieutenant Governor of Cape Breton Island in 1784 but his term here had been abruptly terminated two years later. DesBarres, whose term of office on Prince Edward Island was undistinguished, save for the 1810 act relating to land surveys, was succeeded in 1813 by Charles D. Smith, who remained as Governor for 11 years.

DesBarres concluded his governorship of Prince Edward Island a half century after his former army associate Captain Holland arrived on its shores to supervise the first island survey. Captain Holland and his apt pupil Thomas Wright brought lustre to the title of Surveyor General in their respective jurisdictions. Under their capable direction a solid foundation of surveys had been laid and although land tenure policies continued to be a social and political irritant in the province, conflicts over property boundaries remained conspicuously absent.

In 1810 an act (49 George III) was passed by the Island Legislature "for the establishment of a meridional line to regulate surveyors in this Colony" but no action was taken on this legislation for more than a decade. In June, 1821, a three-man commission made its report on the establishment of such a line on the island. Today, in Charlottetown, it is possible to observe the tangible results of the commission's work. In Victoria Park, located in relation to Charlottetown's business district as Stanley Park is situated in relation to downtown Vancouver, one may readily see a squared stone standing about two feet above the ground on the shore side of the waterfront driveway. This may be described as the "angle stone" as it is the point of a right-angled survey triangle. As one faces the field of Government House nearby two other stones of similar shape may be observed in direct line with the angle stone. Sighting over these three stones it is possible to establish a perfect line to the astronomical north.

Sighting over a similar stone in the cricket field, which is in line with a stone at the edge of the road passing the Park's caretaker's house, one may find true west.

"A.D. 1820" is inscribed on the west face of the angle stone first mentioned. On its opposite face is found the inscription, "VAR. 20 degrees, 18′ 39″. On Prince Edward Island, at the time of Holland's pioneer surveys (1764-65) the compass pointed 15 degrees, 30 seconds to the west of true north. By 1820 compass variation on the island amounted to that indicated on the angle stone. By 1938 the variation had become sufficient to alter the reading to 24 degrees, 30 minutes.

New Brunswick

In 1603 Sieur de Monts received letters patent in which the word "Acadie" or "Cadie" is first used as the name of a region. His grant extended from the "40me degré de latitude jusqu'a 46me" thus including that part of what is now known as New Brunswick, south of the line between Fredericton and Bay Verte in Westmorland County.[25]

Several seigniories were granted to Sieur de Soulanges, including one at the mouth of the St. John River and one in what is now known as the Fredericton area. In the latter grant this area is described as at a place called 'Nashwaak' to be known thereafter as 'Soulanges' on the River St. John "15 leagues from Gemesk, 2 leagues on each side of said River and 2 leagues deep inland". Such a seigniory at the present time would include what is now the community of Marysville, the city of Fredericton and suburbs, the villages of Gibson and St. Mary's and a large tract of surrounding country, enough valuable real estate to make any owner a multi-millionaire. The seigniory at the mouth of the St. John was granted to Charles la Tour in 1635 and the entire shore was granted to Nicolas Denys in 1636. From 1672 on there was a series of great seignioral grants including those of Richibucto, the Upper St. John River valley and the Chignecto Isthmus.

The coasts of Acadia attracted, as we have seen, the curious attention of 15th century explorers from the Old World. These Europeans were primarily navigators rather than trained surveyors or mappers. As navigators their first surveys and sketches were of coastal parts and the mouths of the larger rivers. Samuel de Champlain excelled at this task. In the 200 years between 1570 and 1770 various surveys were carried out in the region by officers in the employ of the French or British governments, men like M. de Chabert and Samuel Holland. Maps were produced and distributed to a limited extent as a result of such surveys.

In 1715 a map by Moll shows Acadia divided into north and south districts. A 1733 map by Popple depicts the whole area as "Nova Scotia". The same term is employed by Mitchell in his famous 1755 map. Because of the unreliability of information sources in those times these maps not only differed from each other but were inaccurate in many details.

More accurate coast surveys of what is now New Brunswick began with the work of the first Charles Morris in 1749 and were continued by men like Lieut. Bruce (St. John harbor and vicinity); John Mitchel in 1764 (Passamaquoddy Bay) and of Thomas Wright in 1772, Joseph DesBarres from 1776 to 1781 and again by Wright in 1790.

The establishment of seigniories in Acadia by the French in the 17th century proved a failure in so far as the achievement of any large-scale settlement constituted the goal of this system of land tenure. In the period between the capture of Quebec by the British and the arrival of the United Empire Loyalists, imperial policy was to try to settle Acadian lands on the tenant system. This method reached the peak of its development between 1758 and 1770 when large tracts of land were designated as townships and the proprietors undertook to bring settlers to these holdings. It was about this time that J. F. W. DesBarres acquired by purchase a rich tract in the Petitcodiac River valley. It was this same land over which extended litigation was to take place following the death of DesBarres in 1824. In any event this land tenure scheme as a whole fell far short of attaining any substantial volume of settlement.

In the 17th century and on what is now the west side of Saint John harbor, Charles la Tour built a fort that was occupied by various French and English garrisons until 1700. The fort deteriorated to a dilapidated state and remained in a ruined condition until 1758 when it was restored and named Fort Frederick by the victorious British. Among the British officers stationed at Fort Frederick was Lieut. John Marr, a sub-engineer. His sketch in colors, a handsome production, is in the Public Archives, Ottawa, and is entitled, "A Sketch of part of River St. John from Partridge Island in Latitude 45 degrees 22 N. to Opaakan (Indian Village) the length contained in this Sketch is near 80 English miles, Taken in November, 1764".

In a corner of this map, and drawn on a somewhat larger scale than the main plan, is a survey of the "Harbour of St. John and of the Environs of Fort Frederick on the North Side of the Bay of Fundy Taken in September, 1764 by John Marr, Sub-Engineer and Lieutenant".

Initial international boundary difficulties encountered by maritime areas of British North America occurred following the Treaty of Paris, 1763. Controversy developed between Americans and Canadians over the precise line separating Nova Scotia (enlarged form) and the colony of Massachusetts. Treaty commissioners had decided upon the St. Croix River, mentioned first by Champlain, as the boundary. Trouble arose over the fact that by then (1763) the name St. Croix, applied to any river in the region, was unknown. Accordingly in 1764, Governor Bernard of Massachusetts despatched John Mitchel, a New Hampshire surveyor, along with a considerable party of assistants, on a small vessel in a determined effort to settle once and for all the identity of the boundary river. The party reached Passamaquoddy Bay on May 26. The entire survey operation required slightly over a month to complete.

John Mitchel's original field book (including a diary of survey) is now in the Maine Historical Society Library at Portland. Mitchel's map of Passamaquoddy is drawn from the actual survey findings and represents an immense advance on predecessor maps, which were not much better than very rough sketches. In turn, Mitchel's production was surpassed by the very accurate and elaborate map based on the complete surveys of Thomas Wright in 1772. Wright's map was the true forerunner of all later maps of the region, at least until 1848 when new British Admiralty surveys were undertaken in the general area.

But the Mitchel map is significant for a number of reasons. It is the earliest known description of the Passamaquoddy area and it is the origin of the conviction later developed by American authorities that the Magaguadavic River was, in fact, the St. Croix. This belief exercised a profound influence on subsequent international boundary commissions operating in that part of the continent. Appearing before the first of these commissions, Mitchel and his assistant, Israel Jones, testified that they had explored the St. Croix to its source. This was a most doubtful claim. Although he was an able surveyor Mitchel, as his diary entries reveal, was illiterate.

"Thursday, May 31, 1764: A pleasant morning this Day. Mr. Jones and my Self and five of our men Imployed Sorveying on the West Side of passamaquoddy Bay and Began at Angle 16:

"Sunday, June 3: Captain flatcher Thought it most Expedient to go to St. Croix (this is the first known use of that name for the Magaguadavic) next day by reason of the Indians who for sum days past Bin Drunk were got Sober . . ."

In 1761 a party of New Englanders from Rhode Island landed at the head of the Bay of Fundy. They settled near modern-day Sackville and thus constituted what may be regarded as the first permanent community of English-speaking people in what is now New Brunswick. While these pioneers were occupied in erecting dwellings, an exploration party, headed by a young surveyor named Israel Perley, made its way through marsh and forest to the mouth of the St. John River. Perley returned to the Governor of Massachusetts with a good report on the latter area. As a result, in the summer of 1762, a group of 20 settlers from Massachusetts made the journey to the mouth of the St. John and occupied a small clearing at the head of the harbor.[26] The long story of the effective settlement of New Brunswick had commenced.

At the time of the great exodus from New York about 3,000 Loyalists set sail for Saint John in the first contingent bound for Canada. Casual shiploads of Loyalists that followed combined to augment the population of the two towns, Carleton and Parrtown, at the mouth of the St. John River. These settlements, in fact, were the beginnings of modern Saint John. In all, about 35,000 Loyalists left confiscated homes and farms to emigrate to British North America. About 14,000 of these war refugees arrived in what is now New Brunswick but which, at that time, was still part of Nova Scotia.

Governor John Parr, in supervising from Halifax the distribution of Loyalist settlers on available lands, ordered that disbanded veterans proceed to certain designated areas in the valley of the St. John northwards from Sunbury. At the outset this movement represented a token occupation only. Most of these soldier settlers drifted back to the two towns at the big river's mouth. By the spring of 1784 the choicest river valley land from Woodstock to the Bay of Fundy was largely occupied. Loyalists overflowed into the valleys of the Miramichi and Petitcodiac. Some of the early surveyors whose efforts contributed in a fundamental way to the success of this occupation included Jacob Allen, Isaac Heddon and Israel Perley. In a letter written in 1785 by Peter Huggeford, a New York physician, he mentions that he arrived as a Loyalist settler at the mouth of the St. John in July, 1783, "whilst the town plot was surveying and before any buildings were erected". In the files of the University of New Brunswick library map collection there is a very old plan of Parrtown made by Deputy Surveyor Paul Bedell. It depicts public squares, private lots, fortifications and public landings.

These new settlers on the west coast of the Bay of Fundy were openly resentful of Nova Scotian administration of their affairs. They were unhappy over Governor Parr's dictatorial direction of their destinies. From 1760 to 1784 all land titles and orders for land surveys emanated from Halifax. Political separation from Nova Scotia became a fervently desired goal. For their part British authorities perceived in such a course of action a means of retaining John Parr in office while rewarding the Fundy Bay Loyalists with public positions within a brand new provincial civil service structure. Thus in June, 1784, political partition was officially proclaimed and New Brunswick (a name honoring the then reigning British house) came into being.[27] Colonel Thomas Carleton, brother of Sir Guy, was named first governor of the new province. Jonathan Odell became Provincial Secretary and George Sproule, the first Surveyor General. The latter office was among the very few provincial positions named expressly in the establishing Order in Council dated June 18. The salary was set at £150 per year.

During the period 1784 to 1825 surveying in New Brunswick was largely performed by either active or disbanded army engineers appointed by the Governor and called

Deputy Land Surveyors. The records and maps left by these men, documents now in the vaults of the Crown Lands Office in Fredericton, reveal that these men were good surveyors. Their returns provided the basis for the earliest maps of the province.

George Sproule, destined to occupy the highly onerous and responsible post of first Surveyor General of New Brunswick for more than three decades (1784-1817), came from New Hampshire in 1785. There is no evidence to indicate that in earlier days he was the Ensign Sproule who assisted Capt. Holland in his Cape Breton Island and other maritime surveys. In his early years in New Brunswick, Sproule was greatly handicapped in as much as he had no proper accommodation for maintaining office records. But he did have the assistance of at least 24 Deputy Surveyors during these formative years. In the George Sproule Letter Books much of his correspondence is preserved. These records are in the possession of the New Brunswick Public Archives in Fredericton.

The first (registered) grant of land in what is now known as New Brunswick was issued on May 28, 1760; the second issued on September 17, 1763. Following these two initial allotments, grants were made with increasing frequency. Here is a typical property description of those early times: "Andrew Ferguson, Esq., a tract of land situate, lying and being beyond Saint Anne's Point on the south-west side of St. John's River on lands commonly known by the name of O. Park, one quarter of a mile extending on said river and containing 500 acres together with an Island or Islands commonly called Sandon Island and containing 100 acres more or less". Vague, elusive descriptions of this type did little to ease the heavy pressures experienced by the newly-appointed Surveyor General and his deputies.

On January 14, 1785, Jonathan Odell issued a proclamation of the regulations to be observed "for the orderly and expeditious settlement of the Province of New Brunswick by the several persons petitioning for Farms, etc. . . ." Regulation Number Three provided that whenever a sufficient number of farms are surveyed and are ready to be drawn for, public notice would be given to any equal number to attend at a day and place to be appointed, when and where a draft [a drawing] of the several lots would be made under the inspection of a Deputy Surveyor . . ." Regulation Number Six provided that all Deputy Surveyors "are to make returns to the [Provincial] Secretary of their several surveys". Regulation Number Nine: "The Deputy Surveyor, as soon as may be after such draft will show each proprietor or his agent the bounds and marks of the lot so drawn by him, which will be considered as a delivery of possession".

At the outset the province was divided into eight chartered counties, namely, St. John, Westmorland, York, Charlotte, Kings, Queens, Northumberland and Sunbury. In 1785 a circular was distributed by Surveyor General Sproule titled: "Additional Instructions to be rigidly observed by Deputy Surveyors in New Brunswick."[28] It warned: "You must be particularly careful that the Instrument you use in all surveys is correct and true and that you insert on the plan you return to me in four pole chains and links the front or breadth of each lot . . . and also the extent of every line you have occasion to run out . . . with its course or bearing inserted on the plan".

Names of Deputy Surveyors sworn in during 1785 and immediately succeeding years include Mather Byles, Richard Holland, John Bedell, Thomas Harper and Stephen Millidge. A Warrant of Survey addressed to Deputy Surveyor Millidge (No. 2 Westmorland) is also on record, dated June 12, 1786: "Pursuant to a Warrant of Survey from His Excellency the Governor to me directed, ordering to admeasure and lay out, at the expence of the parties, for Olive Budrou and 9 others, French Inhabitants, 200 acres of land each, in a Tract of land formerly granted to Richard Bulkley, Esq., at

Memramcook in the County of Westmorland, which said Tract has been lately escheated. . . . And you will make due returns of your proceedings hereon to my office with all convenient speed, with a plan annexed conformable to your general instructions". This document is signed by George Sproule in his capacity of Surveyor General. The records likewise reveal that Mr. Millidge was not formally sworn as Deputy Surveyor until July 25, 1786, more than a month after the issue of these instructions.

In 1785 a survey of the site of the present provincial capital, Fredericton, was completed by Deputy Surveyor Dugald Campbell, formerly a captain in the 42nd Highlanders and commissioned by Sir Guy Carleton to open up military roads in the Upper St. John River valley. He had come to New Brunswick in 1783 as a lieutenant along with a number of disbanded veterans of the 42nd. Originally they had received lots in St. John but in 1784 all moved to Nashwaak in York County, Campbell laid out the existing pattern of Fredericton streets, with Queen, King, Brunswick, George and Charlotte streets intersected by Smyth, Northumberland, Westmorland, York, Carleton, Regent, St. John, Church and Sunbury streets.

But this was not the first survey plan made of the locality. One township survey still on record is that of Sunbury, dated 1768, showing the site of what was then called St. Anne's Point, renamed first Osnaburg, then Fredericton, both names in honor of the second son of George III, Frederic, Bishop of Osnaburg. A certificate is attached to the survey plan, revealing that, with a view to establishing a townsite, the plan was taken to New York to show the authorities there the location of the Point. At that time the place had a population of 15 families. The certification also demonstrates that in those days the vital land settlement decisions affecting that part of British North America were being made in New York.

On January 7, 1789, Surveyor General Sproule wrote to Deputy Surveyor Israel Perley, and added the following postscript to his letter: "You will be particularly careful that the needle of your Instrument you use on this Survey together with the Instrument itself be truly accurate".[29]

It should be noted that a plan of Fredericton in two sheets, signed by Surveyor General Sproule, and dated about 1800, is also on record. "Each of the town lots represented on this plan measures in front and rear 4 poles, and in depth 10 poles, containing one Rood of Land. The streets are 4 poles wide. Scale 3 chains to the inch". There is in existence also a town plot of Fredericton as surveyed April 12, 1832, by Thomas Kelcher. The compass variation is given as 16° 34′ West. The dimensions of blocks are indicated as 10 chains by 5 chains, with streets one chain in width. The town is laid out N 45° East.

Generally the history of the first land surveys in the St. Lawrence River Basin was repeated in the early surveys of property in New Brunswick to the extent that these prepared the way for settlement along the banks of navigable waters. Each settler drew by number his prospective lot and was issued a certificate of possession, authorizing him to occupy the same. In order to meet the pressing need for completed surveys, the surveyors merely traversed the large rivers, monumenting the fronts of tracts to be occupied. The tracts of land thus laid out were of varying depths, depending upon the topography of the country and the number of settlers to be accommodated in any particular area. Some tracts were subdivided into lots of 10 chains in width and 7 miles in depth. Others were 2 or 2½ miles deep and sufficiently wide to include in each lot 200 to 500 acres. The rear or base line of such lots was located parallel to the general course of the river or the trend of the lakeshore governing the front of the lots.

It was the custom in these pioneer times for surveyors to include in their survey areas ten per cent or more in excess of the area to be actually granted. This was a device to help compensate the grantee for waste lands within his boundaries or for land expropriated for road allowances. The underlying purpose was commendable but if, when making his return to the Surveyor General, any surveyor failed to note clearly whether or not the excess was taken into consideration in fixing the recorded dimensions, he made matters exceedingly difficult for future surveyors seeking to restore boundaries and to replace property markers that had been lost or destroyed.

The next stage in the settlement process was to lay out properties at the rear of the first concession of lots. Uniformity of survey patterns, as well as of settlement procedures, was most desirable and in order to aid in achieving this purpose the range system was devised. The lots were so surveyed as to possess a uniform width fronting on a "reserved" road of one chain in width. The four corners of each range were permanently marked. Lots were posted along both sides of a road and division lines between lots were established for a distance of 5 chains. These lines, as required, were extended to the rear or base line of the range of lots. The boundaries were at right angles to the road and generally the lots were 15 chains wide and 67 chains deep, enclosing an area of 100 acres.

The Surveyor General continued to carry out his duties under back-breaking and nerve-wracking difficulties. Not the least of George Sproule's concerns was the pitifully low rate of remuneration attached to his position. The £150 annual salary meant that special sacrifices had to be made by him. Through a lack of funds the Surveyor General was compelled to withdraw his son from school in England. This situation was eased somewhat when in 1807 Governor Thomas Carleton was successful, during a trip to England early in that year, in obtaining the removal of the long-standing instruction regarding the non-collection of quit rents on New Brunswick lands. This provision of new revenue sources meant that somewhat higher salaries could be paid to civil officials. Nevertheless it was a quarter century later, after George Sproule had left office, before the annual remuneration of the Surveyor General reached £600 per year.

George Sproule performed his duties well despite grave handicaps. The results of the international boundary surveys, compiled by him in 1798 into one general map, provided the foundation for all subsequent survey maps of the regions involved. Sproule, in fact, travelled a great deal in connection with various survey assignments. In 1787, for example, at Grand Falls he met Hugh Finlay, representing the Surveyor General of Quebec, in order to discuss the establishment of a line between that province and New Brunswick. In addition there were differences of interpretation over the terms of the Treaty of Paris in relation to the "North West angle of Nova Scotia" which demanded his attention. Sproule was succeeded in 1817 by George P. Kimbell. Surveyors General in the provinces continued to be appointed for life terms by the British authorities until 1837. In that year the provinces assumed the power to appoint such officials.

One of the last acts in office by George Sproule was his letter of instructions to Deputy Surveyor Morehouse, dated July 4, 1817. In regard to the settlement of disbanded soldiers on land between Presqu' Isle and Great Falls and "on both sides of the River Saint John", the Surveyor General directed his Deputy to proceed "without loss of time" to procure assistants as Chain Bearers and Axe Men not exceeding five in all "on the lowest wages you can agree for, bearing in mind that a Ration of Provisions will be allowed to each man" and "to procure a Canoe, either by purchase or hire". Mr. Morehouse was ordered to "lay out lots of 40 rods front at right angles to their sides, all the vacant unimproved land you may find fit for cultivation . . . not exceeding 300 lots".

What may well have been the first survey of an Indian Reserve in the province was provided for in these instructions. "On September 4, 1807, an allotment was made to Neville Bernard for himself and his Tribe of Melicete Indians on the East side of the River St. John, beginning opposite to Tobique Rock and running upstream until it comes opposite to the mouth of the Restook River, you must therefore lay it down on your plan the side lines to be ranged East and no encroachment to be made thereon . . .

"For such persons as you may find already settled and improving, and have families, you may lay out lots of 300 acres with 90 rods front, and for such single men of age as you may find settled and improving, you may lay out lots of 200 acres with 60 rods front, which surveys must be made at their own expence and placed in their true positions on the general plan of your survey.

"In the progress of your survey you must pass over any tracks [sic] of land that you may on careful examination find unfit for cultivation, the fronts of such tracts must be surveyed and measured, so as to enable you to place them on your plan and to continue a general plan of the River . . .

"The lots must be regularly numbered and marked upwards on each side of the River Saint John commencing with No. 1 on the East Side and No. 1 on the West Side. The side lines must be ranged East on the East Side and West on the West Side, and three trees marked, or three durable marks placed on each line, not less than 12 rods asunder—you must note and report the quality of each lot as near as you can estimate.

"As the expence of this Survey will be defrayed by the Government you must keep a Regular daily Journal noting down the duty or service performed each day, to be vouched for by oath if required, and return a copy thereof to me with your report.

"And you will make due return hereon with all possible speed to my office annexing the requisite plan to a scale of 40 chains to an Inch and returning this warrant".[30]

The extent to which the Surveyor General of New Brunswick entered into land allotment matters is evident also in a sample petition or memorial from Anthony Woodward, dated July 25, 1785. . . . "your Memorialist, having lost a large property in New Jersey in consequence of his loyalty, is desirous of obtaining a farm in the District of Beaver Harbour where he has resided with his family from the first of that Settlement and has pointed out to the Surveyor General a lot of vacant land in the interior part of Mascareen's grant where, being back land, it is supposed a Farmer, able and desirous of making immediate and substantial improvement, may be allowed the quantity of 200 acres . . . and your Memorialist humbly prays a grant of that quantity. . . ." This application was addressed to Governor Thomas Carleton.[31]

The functions of the Surveyor General were made clear in a letter from the Attorney General of the province to G. P. Kimbell when he was appointed in 1817 to succeed George Sproule.

"The duties of the Surveyor General of Lands, having exhibited his commission and sworn to the faithful discharge of the trust reposed in him, it is considered a primary object to appoint fit and proper persons his deputies in the several counties, taking bonds with ample security for the faithful discharge of their duty in conformity to His Majesty's Instructions. . . . As the Surveyor General is presumed to have a local knowledge of the lands in the disposal of the Crown as well as of Lands involved in Litigation, it has always been considered right and proper that all Petitions relating to

Lands should in the first instance be referred to him for his report and when he has faithfully exerted his best endeavor to ascertain the truth of the facts stated, he is to report the same for His Excellency the Commander in Chief's [Governor's] consideration and determination".[32]

All Warrants of Survey were to be executed by the Surveyor General or his Deputy and made returnable in six months and if the party to whom they were granted did not avail himself of their benefit within the time limited, the Surveyor General was then bound to report the circumstances. He was expected to keep regular books for entries in full detail of the metes and bounds of all grants of land. It is interesting to note that the Surveyor General was not obliged to interfere in any private disputes over property boundaries or landmarks but it is nevertheless presumed that for "the furtherance of Justice he will at all times be disposed to exert himself to the utmost of his abilities" and to conciliate any differences as well as to preserve inviolable original landmarks that appear to have been fixed "on principles of undeviating rectitude and justice".

Just as the special value of highways was early realized in Nova Scotia, so did the people of the new province of New Brunswick show their appreciation of the importance of surveys involved in primary road construction. In the earliest days of settlement the roads were established across the sandy, sometimes muddy seashores where the first communities were formed.[33] As the population increased roads were built along the banks or ridges to reduce exposure to damage or interruptions by tides or storms. When settlements became more numerous and extended inland, roads were laid out more systematically. Highways, in the main, were divided into two classes, grant (trunk) roads and bye roads. Both types of highways were partly repaired by the inhabitants of the area through which they passed (statute labor). In this manner every resident of the province was legally obligated to contribute his quota of time, effort or money towards the maintenance of roads passing near his home and therefore serving him and his interests. This work was always done under the supervision of a "surveyor" but, as has been already noted, such an officer was not always trained in the arts of surveying.

As Right Hon. Sir Henry Parnell perceptively pointed out in his remarkable *Treatise On Roads*, published in 1839, a book written primarily for the British but adopted and applied in Nova Scotia, "When the state of a society has arrived at a high degree of industry and wealth, so many persons and such quantities of goods are set in motion for the purpose of administering to its business and its luxuries, that it becomes of the greatest importance to construct public roads. . . ."

In regard to tracing the first line of road, Parnell, in his initial chapter, advises that the task should never be undertaken without the aid of instruments "and all local suggestions should be received with extreme caution". The author warned, "To guard against errors it is essential not to trust to the eye alone but in every case to have a survey made of the country lying between the extreme points of the intended new road. For this purpose an experienced surveyor should be employed to survey and take levels of all the various lines that . . . appear favorable. These surveys should be neatly and accurately protracted and laid down on good paper, on a scale of 65 yards to an inch for the ground plan, and of 30 feet to an inch for the vertical section".

Then comes a most prophetic reference. "The map should be correctly shaded so as to exhibit a true representation of the country, with all its undulations of high grounds and valleys, streams and brooks, houses, orchards, churches and ponds adjacent to the line of road. . . . It may be laid down as a general rule that the best line of road between any two points will be that which is shortest, the most level and the cheapest of execution. . . . It may sometimes be proper to make a road deviate from a straight line in order to go through a town. But the expediency of such a deviation must wholly depend on the general object of the road . . .".

In 1786, chapter 32, the New Brunswick Assembly passed an Act "for laying out, repairing and amending Highways, Roads, and Streets and for appointing Commissioners and Surveyors of Highways within the several Towns or Parishes in this Province". There is in existence a Plan of the Great Road, Fredericton to Saint John (1839) "surveyed for Hon. Harry Peters. Road Supervisor: John Wilkinson, Deputy Surveyor".

A journey by stage coach, drawn by two horses, over the mail road from Halifax to Saint John, a distance of 260 miles, took 45 hours to complete in 1854, a total time that varied substantially only in certain brief periods in early spring or late autumn. In that year, by chapter 9 of the provincial statutes of New Brunswick it was provided that the Governor in Council "may cause portions of the vacant Crown Lands to be surveyed and laid off into lots not exceeding 100 acres each" and to sell or dispose thereof by private sale for the price of 3 shillings per acre or up, to industrious settlers, payable in money or by (statute) labor in opening and making such roads as would promote the improvement and settlement of the province.

Roads are useful, instruments are helpful and statutes are significant but men, and particularly leaders of men, remain the most important and most fascinating subjects of this historical study. In the newly-formed province of New Brunswick, Benjamin Marston, who contrived to avoid death by lynching at Shelburne, made an impressive re-appearance in the realm of surveys. Following the harsh treatment from Governor Parr and his dismissal from the public service of Nova Scotia, Marston left Halifax for New Brunswick on December 7, 1784. Sir John Wentworth, who continued to hold Marston in high regard, appointed him a Deputy Surveyor of the King's Woods. In addition Sir John recommended Marston to the favor of Governor Thomas Carleton. "I have fullest reliance in his discretion and shall trust much to his judgment," Sir John confided.

Marston, on his arrival in Saint John, received a cordial welcome, dining with the Governor in company with the Provincial Secretary, Jonathan Odell, several judges and military commanders. With Lieut. Lambton of the army engineers Marston, some time later, made an adventurous exploratory journey to St. Andrews. Early in 1785 he was appointed first Sheriff of Northumberland County. It is not often that one who has so narrowly escaped the noose, so soon afterwards finds himself in the office of sheriff.

From the Journal of his surveys it appears that in 1786 Marston's chainman was John M. Lesdernier. For his services in this connection Marston received 10 shillings per day; his chainman, 2 shillings sixpence. An entry in the Marston Journal of this period reads: "Left ye Indians and began at ye end of yesterday's line (along Etienne River) 531 chains to a point on ye river, there marked a pine 5½ miles and 13 chains from the forks, and here my provisions being almost expended—not more than 4 days left for the party—and one of our 2 axes broke and one of my best men having broke his snowshoes to pieces, I gave over the survey and pushed on with 2 men only". Many Canadian surveyors who followed in Marston's steps in the profession could sympathize with him in his encounters with such frustrating vicissitudes in the field.

Benjamin Marston's career did not end in Canada. He died at Bulama, Africa, on August 10, 1792, after an unsuccessful exploration expedition in that part of the Dark Continent. Although his grave is under far-off tropical skies, Marston made a memorable contribution to the development of surveys in Nova Scotia and New

Brunswick during the critical formative years in both provinces.

Another Nova Scotian, marine and land surveyor, who attained a prominent place in pioneer New Brunswick surveys was Anthony Lockwood. He wrote a memorable book, published in 1818, entitled, *"A Brief Description of Nova Scotia with Plates of The Principal Harbors including a Particular Account of the Island of Grand Manan"*.[34] This volume now constitutes a treasured description of some aspects of early surveying and mapping along Canada's Atlantic coast. Lockwood served as Deputy Surveyor under the second Charles Morris. In his book, at page 74, he refers to the assistance he gave Surveyor General Morris in his strenuous but unsuccessful efforts to persuade Loyalists bound for Shelburne to settle instead along the coast of Guysborough county. On the title page of his book Lockwood is described as a "Professor of Hydrography and Assistant Surveyor General of the Provinces of Nova Scotia and Cape Breton". At page 39 the author states that he was accompanied in the latter capacity in October, 1816 by "5 axemen through lands near Sandwich Bay in search of a favorable position for laying out lands granted Captain Losack and others . . ."

In the year following publication of his book Lockwood was made Surveyor General of New Brunswick. He remained in office until 1823 when he was succeeded by Thomas Baillie. But the giant among all Surveyors General of the province was undoubtedly the first man to occupy that important post, George Sproule. Over a period of 66 years, from the establishment of the position in 1784 until the middle of the 19th century, Sproule served as Surveyor General for half of that period of time. His successors, G. P. Kimbell, George Shore, Anthony Lockwood, Thomas Baillie and John S. Saunders shared the remaining 33 years of service. Shore and Baillie each returned for brief second terms of office. Hon. J. K. Flemming, who became premier of New Brunswick (1911-1914), was the 25th and last Surveyor General in the province as the title disappeared in 1913.

Newfoundland

From the day that the sombre cliffs and grey-green hills of Newfoundland were first sighted from the *Matthew,* the life of the island has been intimately linked with the sea—with the roar of pounding surf, the whisper of ripples on the shores of countless coves, the deep awesome silences of its majestic fiords and bays. Beyond the island lay Labrador, "the only land", legends say, "that actually stood by when Life itself was born".

Five years after the initial Columbus voyage to the New World, John Cabot, a Bristol sailor of Genoese parentage, sailed from the English port on a momentous expedition. He steered northwards along the coast of Ireland and then headed due West "with the pole star at his right hand". His tiny, three-masted vessel *Matthew* of 50 tons was manned by a crew of 18. Cabot held a royal charter authorizing him to sail, at his own expense, to seek new lands in the Western Ocean, provided one-fifth of all territories thus discovered would belong to His Majesty, the King of England.

After 54 days of perilous travel, land was sighted. "Bona Vista" were Italian words that sprang easily to Cabot's lips in the circumstances. Today Cape Bonavista marks the Bristol mariner's landfall early in May, 1497. A casual entry dated August 10, 1497 "To hym that found the New Isle—£10" appears in the Privy Purse accounts of King Henry VII in acknowledgment of this major achievement in transatlantic exploration. Newfoundland tradition credits John Cabot with entering what is now St. John's

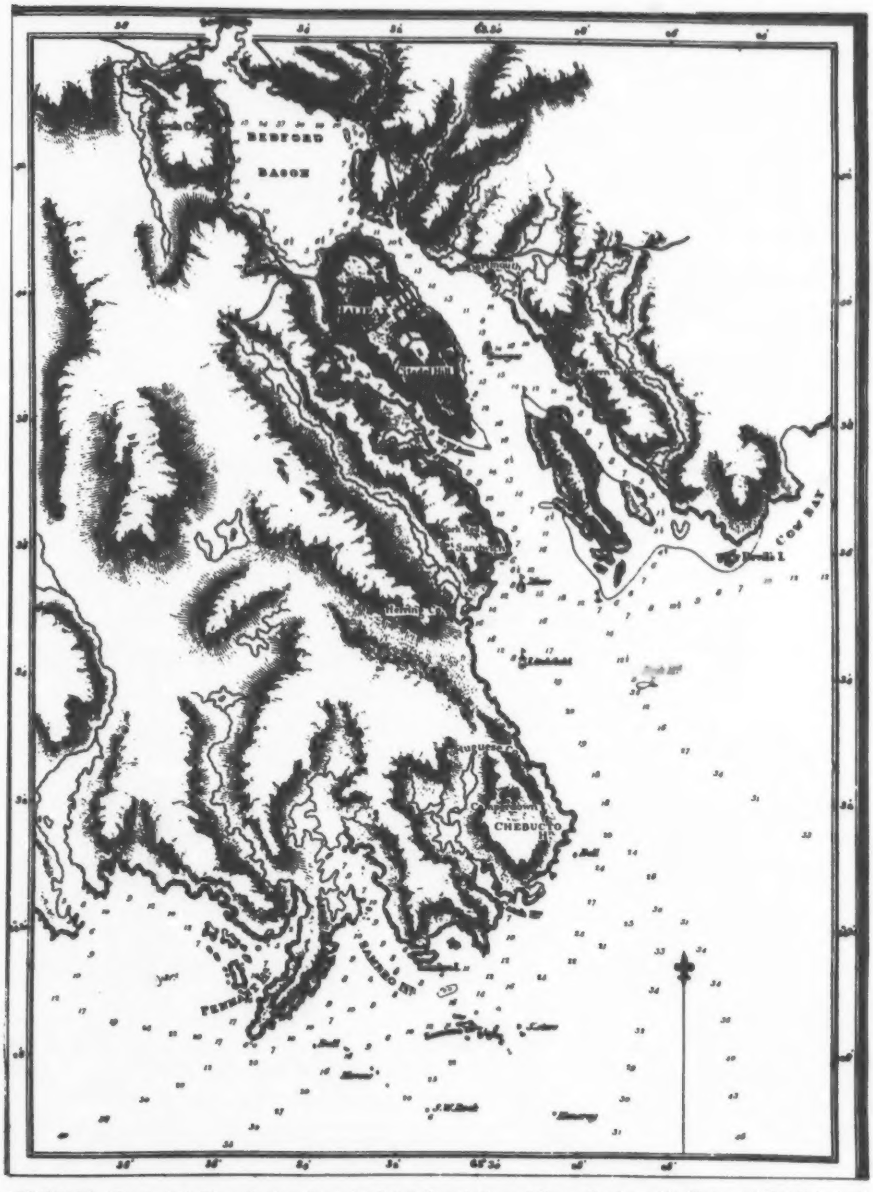
BEDFORD
BASON
Halifax
Citadel Hill
Dartmouth
Sandwich
Herring Co.
COW BAY
Devils I.
Portuguese Co.
Camperdown
CHEBUCTO
Hd.
Bull
SAMBRO Id.
PENNANT
S.W. Break
65° 30'

FIGURE 15. Chart of Halifax Harbor from "A Brief Description of Nova Scotia, with Plates of The Principal Harbors; Including a Particular Account of the Island of Grand Manan" by Anthony Lockwood, Professor of Hydrography, Assistant Surveyor General of the Provinces of Nova Scotia and Cape Breton (London, 1818).

harbor on the day of that saint (June 24, 1497) and naming the place in honor of the apostle. For more than 300 years after that visit, St. John's was regarded, at least by the English as a fishing station rather than as a centre of permanent settlement. Nevertheless this magnificent land-locked harbor, located half-way between Cape Bonavista and Cape Race on the extreme east side of the island, provided a natural base from which English and foreign fishing fleets conducted their operations on the banks.

From 1500 to 1750 little or no surveying or exploratory activity took place on the island itself. The aristocratic overlords of the fisheries considered that their best interests would suffer if the 'New Found Land' was settled and developed to any important extent. Laws of varying severity discouraged any large-scale or long-term occupation of the island, a state of affairs that produced a curious paradox—Newfoundland, one of the first parts of North America to be discovered by Old World navigators, became almost the last part of the New World to be systematically surveyed.

Although John Cabot is generally regarded as the "official" discoverer of Newfoundland, it is certain that venturesome fishermen from the Old World had known its waters before 1497, if not the island itself. In addition there is much evidence to indicate that during the reign of Elizabeth (1559-1603) veteran mariners from Dartmouth, Bedford and other west-country coastal towns knew some of the harbors and headlands of Newfoundland. In fact, Cape Race and Cape Francis were as familiar to 17th century sailors from Devon as their own Land's End. It may be safely assumed that, long before the visit of Sir Humphrey Gilbert, sailings to Newfoundland waters were far from unusual events.

But to stay-at-home Europeans Newfoundland, for almost a century after John Cabot's feat, remained a dark mystery. Some additional light was shed on the true nature of the island by the 1583 voyage of Sir Humphrey Gilbert, a half-brother of Sir Walter Raleigh. He sailed in three small vessels, the *Delight* (120 tons), *Golden Hind* (40 tons) and *Squirrel* (10 tons), arriving at St. John's in midsummer, 86 years after Cabot. On August 5 Sir Humphrey took formal possession of the island in the name of Queen Elizabeth, thus setting the royal seal of English ownership on Newfoundland and confirming its colonial status. Sir Humphrey perished at sea on his homeward voyage when the *Squirrel* sank in a fierce Atlantic storm. He had a clear vision, unusual for his times, of the possibilities of extensive settlements of European colonists in Newfoundland. He had written a tract on the subject and had drawn a map revealing prospects of a Northwest Passage to the Orient. He gave letters of title to English merchants concerning their fishing places in St. John's and nearby ports. At the time of the Gilbert expedition there were about fifty houses at St. John's, built by fishermen who remained each winter to cut timber, construct boats and fishing stages.

Hayes' narrative of the expedition relates that "after this, divers Englishmen made suit with Sir Humphrey to have of him by inheritance theyre accustomed stages, standings and drying places in sundry parts of that land for theyre fish as a thing they do make great accompte of. Which he granted unto them in fee farme".

Inspired, possibly, by the Gilbert expedition, Queen Elizabeth instituted a rather enlightened settlement policy in regard to Newfoundland: "Whatever room or space of foreshore a master of a vessel selected, he could retain it so long as he kept up his buildings on it and employed it for the use of the fishery".[35]

This manifestation of royal wisdom served to increase substantially the Newfoundland fishing industry. It gave enterprising men a more permanent interest in the island and multiplied the number of ship's crews who wintered there. This policy resulted in the building of homes, wharves, fish houses and fish flakes.* The men began to cultivate small plots of land in the nature of vegetable gardens. At first these shore communities appeared around Conception Bay. But the west-country men who made this progress possible, believed they possessed an inalienable right to these shores for the sole purpose of fishing. When Queen Elizabeth died they joined in resisting renewed attempts at settlement.

Some highly restrictive laws were passed directed against colonization. Every captain of a fishing vessel was ordered to bring back to England his entire crew when his expedition had completed its mission. Deserters to the island, once caught, were severely punished. If uncaught, they faced the hardships of winter completely dependent on their own resources. Even legitimate settlers were, at one stage, forbidden to have chimneys on their homes and were not allowed to reside within six miles of the seashore. These laws were not fully repealed until 1811, when, for the first time, a year-round resident-Governor was appointed and officialdom favored, rather than frowned upon, the construction of more or less permanent buildings on the island.

For almost a century (1633-1729) St. John's and the outports were governed by "Fishing Admirals". The captain of the first fishing vessel to arrive in port for the season automatically became chief magistrate of that port until the ships departed in the autumn. This haphazard device for providing civil administration more often than not brought a veritable reign of terror in its wake. Not until the appointment of the first "official" governor, Capt. Henry Osborne, in 1729 did this lawless, brutal period end.

The 17th century, however, was not wholly devoid of efforts to introduce colonists to Newfoundland. The first planned colony on the island is credited to John Guy. In 1610 he sailed from Bristol with three ships and 41 people. He was armed with a Royal Charter from James I, a document granting him all lands between Cape St. Mary's and Cape Bonavista and all seas and islands within 10 miles of the coast. He set up his colony at Cupids, then Cuper's Cove. But roving pirates and hostile fish merchants, through their subversive agents, played havoc with John Guy's settlements, burning down homes, smashing boats, cutting nets and driving off cattle. Before long he returned, discouraged, to the relative security of England.

Richard Whitbourne, who had served, 32 years previously, with the Gilbert expedition to St. John's, was sent out from England in 1615 to establish at least some measure of law and order. Not long after his arrival he was captured by pirates and held prisoner for 10 days. Capt. Whitbourne, eventually Sir Richard, was a devout high church man and exceedingly versatile — being by turns sailor, traveller, author, judge and governor. In his famous "Discourse", a book much favored by King James (who gave the author the sole right for 21 years for printing and selling it) Sir Richard states:

"Those flies [mosquitoes?] seems to have a greate power and authority upon all loytering people that come to Newfoundland, for they have the property that when they find any such, lying lazily or sleeping in the Woods, they will presently bee more nimble to seize upon them than any Sargeant will be to arrest a man for debt; neither will they leave stinging or sucking out of the blood of such sluggards until like a beadle they bring him to his Master, where he should labour; in which time of loytering those flies will so brand such idle persons on their faces, that they be known from others as the Turks doe their slaves".**

As a leader and a colonizer Sir Richard is highly regarded in Newfoundland to this day. Hon. R. Bond, in saluting the memory of this outstanding pioneer, named the Avalon peninsula town after him, the first important railway junction on the island.

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*Platforms for dry curing.

**The book sold through seven editions from 1621 to 1623.

In 1617 Capt. John Mason, R.N., met with a goodly measure of success on a mission similar to Sir Richard's. He explored the coast of Newfoundland, made a fair map of the island and established a flourishing fish trade at Cupids. His rule lasted six years. Mason proved to be a strong, stalwart character. An Oxford classical scholar, he made the first English hydrographic chart, based upon actual surveys, of Newfoundland waters in certain limited localities. It was the first such chart to possess any degree of accuracy. He also wrote a treatise entitled: "A Brief Discourse of the Newfoundland", published in 1620. He died in 1635 and is buried in Westminster Abbey.

The modern communities of Renews and Trepassey are located on the sites of two other settlement projects of the 17th century. Sir William Vaughan, author of *The Golden Fleece* brought a small party, mainly Welsh, to the latter locality in 1616. But the venture proved to be an ill-fated one. Gradually French fishermen occupied the better shore properties facing Trepassey harbor, dislodging the Welsh who drifted nearer to St. John's. Falkland, Lord Deputy of Ireland, led a group of Irish immigrants in 1619 to the place now occupied by Renews. They, too, were elbowed out of their original holdings by the French and settled farther north. Today the Newfoundland coast from St. John's to the head of Placentia Bay is inhabited by descendants of the Irish people first introduced to the island by Lord Falkland.

In 1621 Sir George Calvert, the first Lord Baltimore, applied for a royal charter to colonize Newfoundland. In the following year he received a grant of part of the southeastern peninsula and named his picturesque domain, "Avalon". Baltimore spent £40,000 on this colony and joined it with his family in 1627. His wife and son, however, could not endure the climate and in 1629 left for Virginia, soon to be followed by Lord Baltimore and many of his colonists.

No vestige of these early colonizing attempts remain today. Even the regional names of settlements have disappeared from maps, all save Lord Baltimore's "Avalon".

Mention has been made of John Mason's map. Prowse points out that this map could not have been entirely drawn by him. Many of its features are traceable to older maps, mainly those of French origin. In his treatise Mason takes note of at least three marked advantages possessed by Newfoundland, namely, "nearness to our owne home", lively commercial intercourse and relative immunity from savages.

In summing up these various events and enterprises of the 17th century it may be said that Newfoundland was colonized not so much by aristocratic patentees as by toil-hardened settlers, some of them escaping from rigorous Stuart laws, but clinging tenaciously to the new land they had decided to make their home. From the first they carried on a rude agriculture, raising vegetables and cattle. Game and fish served to supplement their diet.

Hon. Joseph R. Smallwood, present premier of Newfoundland, in *The Book of Newfoundland* edited by him in 1937, describes in volume one, under that title, a typical outport "Brig Cove". The cove is described as about a quarter-mile in depth and its shores accommodate some 200 houses and about 1,000 people. The homes, built near the ocean, leave but a narrow strip of foreshore to contain the fishing stages, fish-rooms and fish flakes. The flat-roofed houses are small, two storeyed and built of wood and generally painted yellow, red or brown.

No effort whatever was made, so this author points out, to lay out such a settlement so that it would take on the shape and appearance of a town. Not built in ordered rows, the homes face whatever point of the compass their highly individualistic owners might favor. The main street straggles around the curve of the cove, separating the fishing stages from private dwellings. The street, about 12 feet wide, could hardly be more stony or uneven. The only other streets in Brig Cove are narrow lanes twisting in all directions. No local authority existed to plan the community's growth or to regulate building construction.

The home-owner's garden is located "in back" from the settlement, possibly a half-mile from the coast. The land, as in the time of the first settlers, is free for the taking. True, it needed to be staked out and measured by a government surveyor. But as this latter step required the possession and transfer of hard cash, often these official formalities were not observed. The owner might just mark it off by himself and with luck, in the course of many years, manage to fence it. Each settler in Brig Cove took as much land as he desired, the earliest to arrive enjoying the best choice of available property.

Gradually all suitable agricultural land near the cove was occupied or, in any event, came to possess an owner. Though perfectly good land might be readily available "in back" yet the farther one retreated from the coast, the more difficult it became to work that land economically. After all, it was along the coast where basic livelihoods were earned. Here, then, was another important aspect of the ancient dilemma faced by many Newfoundlanders, namely, "cultivation interferes with fishing".

The initial surveys in and near St. John's were performed by garrison engineers at that point. One of these officers, Capt. Robert Pringle, R.E., left his lasting mark on the history of Newfoundland. The Naval and Military Museum, St. John's, displays Pringle's "Plan of Survey of the Hill Above the Church Within the Harbour of St. John's (including the location of an Entrenchment Battery for its Defence)". The scale of this map drawn about 1775, is 200 feet to the inch. In the same museum collection there is a Plan of Fort Townshend, St. John's, dated 1776. Capt. Pringle also began road construction in St. John's in 1773, when the entire population of the island did not exceed 8,000.

Francis Owen, Master of His Majesty's ship *Agincourt,* as a result of a survey made in October, 1798, produced a chart of St. John's harbor, complete with sailing directions for entering same. This plan, prepared on a scale of 100 fathoms to the inch, indicates in addition to water depths, the location of forts and other buldings, and access roads to the fort and gun batteries.

The struggle for supremacy in Newfoundland between the great powers of the day, France and England, lasted nearly 300 years. Control of the island fluctuated between the two nations. By the Treaty of Utrecht in 1713, full sovereignty over the island was ceded by France to England, the French retaining the right to resort to certain sections of the coast (which came to be known as the Treaty Coast) in connection with their fishing operations. The final battle of the Seven Years' War was fought on September 19, 1762, when Col. Amherst captured St. John's. This victory ended French rule on the island. The days of French supremacy are commemorated by numerous island place names, including Notre Dame Bay, Conception Bay, Placentia, Rose Blanche, Renews and Trepassey Bay.

As the 18th century came to an end, Thomas G. W. Eaststaff, draftsman and a captain of the Corps of Royal Military Surveyors, arrived in Newfoundland. His ability as a surveyor impressed the highest authorities on the island. From 1804 to 1806 he was engaged in the preparation of a comprehensive plan of St. John's. Soon after the plan's completion Capt. Eaststaff was appointed Surveyor to the Civil Government under the regime of Governor Sir Erasmus Gower. He continued in this post until 1816 when he was recommended for the permanent position of Crown Surveyor in Newfoundland.

A highly revealing exchange of letters took place in 1819 and 1820 involving Lord Bathurst, Secretary of State in London for the Colonial Department, Sir C. Hamilton, Governor of Newfoundland and Capt. Eaststaff. On October 8, 1819, Eaststaff wrote from Quebec to Lord Bathurst stating that he had been compelled "to write to his Agent in Newfoundland to sell all his property to pay . . . just and lawful debts". However (he confessed), to his dismay he had received word from Governor Hamilton that three of his lots, totalling an acre, could not be sold because, in the Governor's words, "the lots had been granted . . . to Mr. Eaststaff as connected with his situation as Surveyor of Lands, [which] by his removal from Newfoundland, is cancelled". Mr. Eaststaff protested to Lord Bathurst that this version of the transaction was incorrect and that the Governor "must have been grossly deceived by his Secretary" since the deed stated that "the grant with permission to build is given as a compensation for the road called Gower Street". Apparently Lord Bathurst was favorably impressed by Eaststaff's plea. He wrote to the Governor from Downing Street on January 8, 1820. His Lordship did not mince words. "It appears to me [the lots] have been given decidedly as compensation for the road allowance" and pointedly added, "I shall be glad to hear that you [have] permitted him to dispose of the three lots . . . without [further] delay . . .".

The survey instructions given by Governor Sir Richard G. Keats to Eaststaff on November 26, 1814 are of considerable interest:

"Whereas it is necessary to make a general survey of the lands without the Town of St. John's and to plan and register the several grants made by myself and former Governors, . . . you are hereby authorized and required to make a survey of such lands accordingly and it may be necessary to enter at proper times into any ground or enclosure occupied by individuals and to require of them a sight of the Grant or Authorities by which such lands are held by them, which lands and titles are to be registered by you according to the form No. 1 herewith delivered, and in case you should meet with any interruption or opposition in executing the aforementioned service you are to represent the same to the magistrates who are hereby authorized and required to afford you the necessary aid to enable you to effectually perform this service in the execution of which you will observe due civility and the parties are to be put to as little trouble or inconvenience as circumstances will permit of. Before you enter on this service you will take and subscribe an Oath to make a true and faithful survey and Register, according to the best of your knowledge and ability".[36]

When Eaststaff left the office of Surveyor to the Civil Government his annual salary, exclusive of fees, was £200. Some years later this salary was raised to £300 and by 1843 the remuneration had reached £500 but this was in lieu of all fees of office.

During the Eaststaff period the King's Printer, J. W. Withers, wrote in the first volume of the *Royal Gazette*, August 27, 1807, describing the social conditions in St. John's during the previous year. It was a time when the town's total population was about 6,000. The Withers report sheds light on the spirituous, if not the spiritual life of the port in those lively days. There were 33 taverns in robust operation there, places such as "Rose and Crown", "Bunch of Grapes" and "Tar for All Weathers".

"The quantity of spirits consumed in St. John's at this time", comments the Newfoundland historian, H. M. Mosdell, "was simply amazing. The imports of rum alone for an island population of about 20,000 was about 220,000 gallons or about 11 gallons per head for everyone in Newfoundland and this besides brandy and gin, wine, beer and cider. Moreover, consumption was about 5 or 6 gallons per head. When we think that our consumption now [in the 1920s] is about one-third of a gallon of all ale, wine and spirituous liquors, we begin to realize how fully and freely those eager souls of a hundred years ago slaked their devouring thirst"![37]

The office of Surveyor General of Newfoundland existed for nearly 80 years, beginning in 1821 with the appointment of George Holbrook (1770-1832), the man who had made a marine survey of the east coast in 1813. He remained in office for 11 years and was succeeded by Joseph Noad, well known for his Noad maps of Harbour Grace.

Edmond Hanrahan, who followed Joseph Noad in the office of Surveyor General, occupied that position for five years, 1855 to 1860. Hanrahan, a member of the House of Assembly for Conception Bay for ten years and for Carbonear for an equal period, was also Chairman of the Board of Works. From 1863 until his death in April, 1875, he served as a magistrate. He was succeeded by John H. Warren, M.H.A., for Bonavista from 1855 to 1874. Warren was Surveyor General from 1861 to 1878.

Road surveys formed an important activity at this stage of the island's development. The Newfoundland authorities, in commissioning William R. Noad to draw up a plan of St. John's, indicated the limits of his surveys. The area extended from Temperance Street to Patrick Street and from the waterfront to the parade grounds. Cochrane, Gower, Prescott, Harvey (Road), Adelaide, Queen, Waldegrave and Patrick Streets were, at the time, newly opened thoroughfares. New Gower, Water and Duckworth Streets were widened and straightened somewhat about this time.[38]

The first road constructed outside the boundaries of St. John's was built in 1825, probably by the Royal Engineers. The island governor at the time, Sir Thomas J. Cochrane, had obtained a grant for the purpose from the British government. The road linked the capital to Portugal Cove over a distance of about nine miles. This development manifested a new official trend towards the encouragement of settlement.

Coastal waters afforded a relatively easy and natural means of communication between settlements but Newfoundlanders early in the 19th century became fully sensible of the basic value of suitable roads and highways. On November 16, 1835, Josiah Blackburn, Deputy Surveyor, made a report to the government of his survey of a line of road between Holyrood and Placentia:

"The Salmonier River is too great a breadth [about 90 yards] to admit of a bridge being easily erected over it, and the rush of the tide is so great that none but a bridge of the utmost stability could resist it, a Ferry therefore would be necessary here. The advanced state of the season . . . and the fatigue of myself and the five men with me, having been a month in completing the survey, and the greater time without any shelter but such as temporary tilts [lean-tos or tents] afforded us, prevented my going farther . . . Whenever the line of road ran through woods, I opened a path of not less than three feet wide and the line throughout is marked by [85] posts, [each] bearing a board of 7 inches by 2 inches with the words 'Rd. to Placn.' painted thereon".[39]

The following year there was a petition from inhabitants of Broad Cove praying that a branch road be opened from Cody's Well, on the way to Portugal Cove. The Governor, Capt. Henry Prescott, thought the matter worthy of consideration.

"The humble petition of the inhabitants of Broad Cove and places adjacent upon the southern shore of Conception Bay", so the document declared, "sheweth that petitioners reside near Broad Cove, a settlement distant about 10 miles from St. John's and that there is no direct road to their settlement from the capital, but that petitioners when bringing provisions from St. John's or taking up to town the produce of their farms, or going thither on other necessary business, are obliged to go by way of Portugal Cove . . . Your petitioners therefore request Your Excellency recommend that some *competent surveyor* be employed to make examination into the practicability of cutting a direct path".[40] (author's italics)

It was in this same year of 1836 that general instructions were issued for the guidance of surveyors in marking out roads:

"1. To ascertain by careful examination from commanding eminences or by other judicious means, the most direct line of Road, then to keep closely to that line as may be consistent with the nature of the country.

2. Steep hills and [any] ponds must of course be avoided and rivers must be crossed where the breadth will not be inconveniently great for the construction of bridges.

3. Trees are to be marked in such a manner that the road may be distinctly traced without the possibility of mistake—when it is required to be made.

4. There must be delivered to the Secretary's Office plans of the lines of Road so marked out, being particular as possible in the bearings and distances, giving a general description of the country, the size and character of timber and pointing out such branch roads as you may think desirable.

5. You must always bear in mind that these lines are designed for high roads fit for the passage of carriages and carts of all descriptions".[41]

In Newfoundland road allowances were taken out of grants of property but compensation was given landowners thus deprived of some of their land. There is on record an undated deed of land, signed by Surveyor General George Holbrook in the reign of William IV (likely in the year 1831) as follows: "Greeting: Give and Grant to Martin Ryan of St. John's, his Heirs and Assigns, all that Piece and Parcel of Land situate and being at St. John's River near Waterford Bridge, leaving a Public Road on the North on the banks of the said River—Waste land on the East and West —500 yards back and also on the South one Hundred and Seventy Six Yards . . . described in the diagram annexed and containing 20 acres. Lot 238. Martin Ryan".[42]

All the great road improvements in the vicinity of St. John's in the 19th century began under Governor Cochrane. The roads to Topsail, Bay Bulls and Torbay as well as to Portugal Cove, although these projects had been commenced before his arrival on the island, were pushed forward to completion under his energetic direction. The pace of road construction was maintained under Governor Capt. Henry Prescott (1834-1841) and Sir John Harvey, who succeeded him.[43]

In 1836 Frederick R. Page, a surveyor, submitted to the authorities a lengthy and detailed report of a "Survey of Intended Line of Road between Cat's Cove Bridge [near the head of Conception Bay] and the Bottom Arm of Ship Harbour [on Placentia Bay] being part of a Great Western Main Line of Road extending 35 miles, to facilitate intercommunication between the western shores and the metropolis of the island".

Apparently, however, the public finances of the island could ill afford the "luxury" of road-building activities. Highway surveyors were poorly paid for their services, when they were paid at all. In connection with the making and repairing of roads of the Central District it was reported, for example, in 1836 that "In consequence . . . the [Road] Commissioners have not the means of paying Mr. Thomas Byrne [the surveyor appointed under 4 William IV, chapter 6] but a small part of his salary. That the said Mr. Byrne is still employed in superintending the levelling of snow in the streets during the winter months and has yet to receive the sum of £50". This constituted a new kind of levelling for land surveyors.[44]

The unpaid Mr. Byrne went on to higher realms of public service. A native of

Kilkenney, he became M.H.A. for Harbour Main district from 1855 to 1859. Previous to his election he had submitted, in 1840, a report to the Assembly on the "State and Condition of the Streets, Roads and Bridges of Newfoundland". At the time of his death on February 4, 1869, at the age of 70 Thomas Byrne was described as a "government surveyor".

Road surveyors, for their part, were not always punctual in submitting accounts for work accomplished. In the 1836 report already alluded to, there was mention also of sums disbursed to three surveyors "for laying out the best lines of Road from St. John's to Holyrood and Placentia, Trinity and Conception Bays:

Joseph Blackburn	£85
Joshua Green	£40
B. Sweetland	£80

N.B. The above named surveyors have not yet finished their surveys nor furnished any accounts of their disbursements . . ." On January 14, 1836, it was ordered in the message of His Excellency the Governor that the reports of Blackburn, Green and Sweetland of their road surveys be printed for the use of members of the House of Assembly. On February 23, Mr. Sweetland submitted an account to the Colonial Secretary covering the concluding part of his survey of the line of road from the capital to Trepassey.

In a report dated June 10, 1837, from the Commissioner of Roads and Bridges for the Ferryland District to the Colonial Secretary it is revealed "that unforseen circumstances retarded the appointment of a superintending surveyor until October 1, 1836, when Lieut. Robert Carter, R.N., the person appointed, was instructed to proceed forthwith to Bay Bulls and survey from thence to Cape Broyle, keeping in view the line stated to be surveyed by Mr. Sweetland the preceding year . . . and that by the time the survey was completed from Bay Bulls to La Manche Bridge, the weather set in so severe as to put a stoppage to further progress with the work until the spring . . ."

In the first six decades of 19th century Newfoundland three men stand out prominently among the trail-blazers who explored and surveyed the island during that formative period in its development. William Epps Cormack (1796-1868), John Beete Jukes (1811-1869) and Alexander Murray (1810-1884), all of them graduates of British colleges, pioneered in the introduction of scientific methods to the opening up of wilderness areas of the colony. James Patrick Howley (1847-1918) who, like Cormack, was Newfoundland-born, became assistant to Murray in 1867 and continued for many years in the distinguished tradition established by this dedicated triumvirate.

Cormack, born in St. John's of Scottish parents, was the first white man to cross Newfoundland from one coast to the other. In 1822, accompanied by a Micmac guide, he made the rugged journey on foot from Smith's Sound on Trinity Bay to the shores of St. George's Bay. Nine weeks were required to cover the distance of more than 205 miles. By this remarkable achievement Cormack, a graduate of Edinburgh University, paved the way for later and more systematic explorations of the interior.

There is little doubt that Cormack was inspired to undertake his expedition by the earlier feats of Lieut. Cartwright and Capt. John Buchan on sorties up the Exploits River. Capt. Buchan made sketches of the territory he traversed in this manner but his promising career was cut short when he met death at the hands of Indians during his second expedition. Although Cormack failed to leave maps he produced a valuable record of his field observations in a volume entitled, *Journey Across Newfoundland*, published in St. John's in 1856. Cormack became deeply interested in the origins and fate of the island's Beothuck population. He was aware of the existence of one Beothuck

Indian woman in St. John's and in 1827 made an intensive but unsuccessful search of Newfoundland for other survivors of the tribe. The woman died in 1829. Cormack remained in Newfoundland until 1836 when he departed for the Antipodes. Eventually he returned to New Westminster, B.C., where he died in 1868.[45]

By 1832, a decade after Cormack's epic journey, Newfoundland had attained a measure of representative government. Partly as a result of this constitutional development funds were provided six years later by the House of Assembly for the purpose of financing a geological survey of the island. In an address by Governor Prescott at the Assembly opening on May 17, 1838, His Excellency announced, "It gives me great pleasure to inform you that the President of the London Geological Society has, at my request, recommended a gentleman fully competent to undertake the Survey for which you made provision last year. This gentleman, a graduate of Cambridge to whose merit high testimonials have been furnished by the Geological Professor of that university, is already arrived and has entered upon his arduous task with zeal and alacrity". For John Beete Jukes that was a commendably fast start but, technically, he had beaten the legislative gun by several days.

"I cannot deny myself", the Governor continued, "the gratification of quoting the closing paragraph of the professor's letter on that occasion — 'What the survey will lead to it is impossible to judge in our present ignorance of the structure of the Island, but I cannot help anticipating great good, both economical and scientific. In the name of my brother geologists of England I offer you our best thanks for the noble example you have set to our other Colonies'."

Members of the House, realizing that through their initiative a leading geologist of his times had been attracted to the task, and intent upon receiving proper credit for their foresight and discernment, replied fittingly on May 20 to His Excellency's address: "It is particularly gratifying to the Assembly that a gentleman having the high scientific character of Mr. Jukes should be induced to undertake the Geological survey of the Island. This is a subject upon which the Assembly feels great interest — *originating as it did with them* — they are doubly solicitous it should eventuate in enhancing the physical character and developing the internal resources of the country, directly promoting the rapid and permanent advantage of its inhabitants". (author's italics) The House ratified the appointment of Jukes that same day.

Jukes, whose arrival in Newfoundland in 1838 on the clipper brig *Diana* had been a shade premature, spent the years 1839 and 1840 in exceedingly intensive exploration and mapping work in the interior of the colony. In 1839 he published his *Report on the Geology of Newfoundland*, complete with map, returning to England on H.M.S. *Spitfire* the following year. In 1842 he published *Excursions In and About Newfoundland* in two volumes. Later he surveyed in Australia and in North Wales. In 1851 he was named Director of the Irish Geological Survey, dying in Dublin on July 29, 1869.[46]

From 1830 to 1860, with the single important exception just described, no significant surveying or mapping took place in the interior of Newfoundland. In 1864, however, history was repeated and, for the second time within a quarter of a century the Assembly endeavored to place the geological survey of the island on a systematic and permanent basis.

In his address at the opening of the Assembly on January 28, 1864, the Governor, Sir Alexander Bannerman echoed his predecessor, Capt. Prescott: "Public attention has frequently been directed by many intelligent individuals to the necessity of a Geological Survey of the Colony and the importance of such a Survey has become, every day more apparent. It must be gratifying to every one who takes an interest in this Country to learn that there are now at work Two Mines, a Lead and a Copper one, each employing 100 persons, and successfully conducted by enterprising Capitalists, in limited localities, whilst the vast unexplored territory of this Island, as well as its extensive adjunct dependency, Labrador, opens a wide field for the investigation of a Geologist, and justifies encouraging hopes that the Mineral resources of Newfoundland may yet prove most productive and afford remunerative employment to its people.

"The government lately opened a correspondence with Sir William Logan on this subject and they have reason to believe that eminent geologist will afford such information to this Legislature as may induce it to make every endeavor to promote this important object."

In its dutiful response to the opening address the House agreed that "a careful and thorough Geological Survey, carried out by competent persons, would be a measure of inestimable importance to the Colony which may one day become as remarkable for its mineral resources, as it is now for its Fisheries".[47] This sentiment reflected a growing feeling among Newfoundlanders that it would be wise to avoid becoming a one-industry colony, no matter how imposing in importance that industry might be.

Sir William Logan, first Director of the Geological Survey of Canada, proved most helpful to the Newfoundland administration in this connection and loaned to the colony his valued and highly competent second in command, Alexander Murray. In all the circumstances it was a generous gesture but the close connection between Logan and Murray was to lead, innocently enough, to considerable embarrassment to the latter. A highly suspicious House of Assembly conducted a thorough investigation in 1869 through the agency of five-man committee, including John H. Warren, the then Surveyor General. In Murray's testimony before the committee we find a summary of his professional career in Canada prior to the loan of his services to Newfoundland.

"Early in 1843 when W. E. Logan, Esquire [he was knighted in 1856] accepted the directorship of the Geological Survey of Canada", Murray testified, "I was appointed chief assistant in that organization on the recommendation of Sir Henry de la Beche, at that time Director General of the Geological Survey of Great Britain. By reference to the Preface to the *Geology of Canada, 1863* it will be seen that I 'blocked out' nearly the whole of the geology of Western Upper Canada in the first instance. I was for two seasons engaged in examining and surveying Gaspé Peninsula. In 1846 I was employed under Logan in surveys of the copper region of Lake Superior and was at work for many years on the geology of the country between Lake Huron and the Ottawa River". At this point Murray quoted an unsolicited letter of recommendation he had received from Sir R. I. Murchison, F.R.S., a most distinguished British scientist: "I have hereby great pleasure in testifying that Alexander Murray who has so long served as a Geological Surveyor in the Province of Canada, has borne a very conspicuous part in producing maps and sections of that country which have obtained approbation of men of science of all countries. The arduous labours in tracts never before surveyed and in which he was compelled to define their topography before he could define geological boundaries, can scarcely be over-rated". There was also reference made to a laudatory letter received by Murray from Archibald Geikie, F.R.S., Director, Geological Survey of Scotland, "I know of what value your work has been in bringing to light the economical value of the rocks of Canada and in unravelling those scientific problems for which the survey of Canada has obtained so world-wide a reputation".[48]

Alexander Murray continued in his evidence before the committee: "In 1864, my first year in Newfoundland, my operations were chiefly confined to the great northern peninsula . . . Previously to my arrival here, Mr. James Richardson, one of the staff under the direction of Sir William Logan, had made a partial survey of the northwestern shores and the purport of my visit to the northeast side was to join my work with his . . . I found discrepancies most conspicuous in coast charts on the coast of St. George's Bay and on Humber Arm, where errors of position were found to exist from one to two minutes of latitude and sometimes more in longitude. The whole work of combined surveys of the 1865 and 1866 seasons, including the corrected coast line was prepared on the usual scale of one inch to the mile, later reduced and submitted on the scale of 4 miles to one inch".

Born at Crieff, Perthshire, Scotland, Murray lived out his post-retirement days there. Educated at Royal Military College, Portsmouth, he served in the British Navy for ten years, 1824 to 1834. Fond of using nautical terms in his everyday conversation he became affectionately known to Newfoundlanders as "Captain" Murray. "A bright, genial, pleasant looking man", according to Dr. Robert Bell's description of him, Murray possessed a splendid physique and was uncommonly fond of early morning cold water dips. But early in the summer of 1866 he suffered a crippling accident. He severed the Achilles tendon in one leg but insisted on completing the season's field work. His resolution was admirable but the effect of his determination was to leave him lame, though not incapacitated, for the remainder of his life.

Murray's strenuous exertions on surveys during the following summer aggravated the tendon injury and finally compelled him to abandon work for the balance of the season. "In 1867", he testified at the inquiry, "in consequence of a serious accident during the previous season's explorations I was obliged to repair to England and not until August was I sufficiently recovered to resume". Additional light was shed on this mishap and its aftermath in a later passage in Murray's evidence.

"In 1866", he testified, "I made extensive survey of the Humber Valley, ascending and descending violent and dangerous rapids, carefully triangulating the country and minutely noting all particulars that came within my reach while I was at the same time a helpless cripple, having to be lifted in and out of my canoe and even to be supported by one of my two Micmac Indians while I worked my theodolite. In many cases my only means of locomotion during the autumn when I triangulated parts of Bay St. George, was on my hands and knees and thus getting suitable positions for taking observations. The same autumn I persevered, working on as best I could, in pain and suffering, from August 15 to November 22 because I was unwilling that the expense that the government had been put to in chartering a vessel for my convenience should be thrown away".

Murray made another character-revealing comment in his remarks before the legislative committee. "With respect to the shortness of my 1867 season", he stated, "I returned to St. John's at the end of September and I had one very good reason for doing so and that was I had no funds to pay further expenses, unless they came directly out of my pocket. I had been warned before going out in the field that I would be limited to £225 for all expenses, exclusive of my own salary". He went on to confess that even with the exercise of the utmost frugality he overspent that allotment by £54!

The committee was advised by Murray that in 1868 his survey activities took him to Conception, St. Mary's and Placentia bays. A survey was also made by him that year of La Manche mining locations and "a large tract of country reaching into the island's interior was connected upon a system of triangulation".

All this and much else failed to dispel misgivings of the legislators at St. John's. These doubts had stemmed from a letter from Murray to H. W. Hoyles, Newfoundland's Attorney General, soon after the appointment of the geologist. The letter was mailed from Montreal and was dated January 3, 1865.[49]

"By letters received here from Sir William E. Logan", Murray wrote, "I have reason to apprehend that his return from England to this country is not likely to be nearly so soon as I was led to expect and it may be that, consequently, the Report of my proceedings in Newfoundland will also be delayed as it is of *the utmost importance that he should personally inspect what has been done* and approve for publication. But I will submit the following sketch of what has been ascertained for the information of the Legislature, upon which a Report will hereafter be constructed . . ." Thereupon follows a lengthy 'sketch' of Murray's findings. (author's italics)

It appears that in those formative times the Newfoundland administration was intent on keeping geological reports highly confidential. From Murray's guileless letter it seemed to the law-makers of St. John's that a solemn trust was being violated by the disclosure of information to another Canadian official. But the investigation served to clear the air. The committee reported that "it was able to supply highest testimonials to the scientific and practical capacity and eminent attainments of Mr. Murray as a Geological Surveyor, with evidence of his useful labours in other countries, especially in Canada, in connection with Sir William Logan, whose first assistant he was . . . The committee expresses satisfaction over Mr. Murray's industry and application, as of his ability and capacity . . . The committee is also quite satisfied with Mr. Murray as a Geological Surveyor, with evidence of his useful labours in other countries, of this Island and that no preferential information or advice of any kind is given to persons residing elsewhere, but that the earliest reports are presented to this Government and Legislature while we have the advantage of the subsequent scientific elaborations of Sir William Logan and his staff . . ."

Alexander Murray's own mind and conscience were clear on the issue. He told the committee plainly, "If the 'impressions' spoken of are meant to imply that either Sir William Logan or myself are capable of using information for individual personal interests, such insinuations are unworthy of indignation and need only be treated with the utmost indifference".

An interesting sidelight of the committee investigation was the testimony offered by Professor Robert Bell, Professor of Geology, Queen's University, Kingston. The questioning of the professor disclosed the inevitable and abiding political concern of all legislative bodies with the practical benefits to be derived from government-sponsored technical surveys.

"Q. Have you been engaged upon the geological survey of Canada?

A. I was engaged upon that survey for ten years, 1857 to 1867.

Q. Do you suppose that the system pursued is the best?

A. A correct geological map cannot, of course, be constructed without a correct topographical survey and where no such survey has been made, Murray's only course is to make one himself, which he is well qualified to do.

Q. How long has the Geological Survey of Canada been in existence and how long has Mr. Murray served in that department?

A. The survey went into operation in 1843. It was formed in 1842. Mr. Murray was connected with it from its origin up to the time of his present appointment, with the title of Assistant Provincial Geologist, or next in rank to its illustrious director, Sir William E. Logan.

Q. What have been the practical results and what benefits have been derived from the publication of Mr. Murray's reports and surveys in Canada?

A. Publication of these reports and surveys has been the means of giving to the world a knowledge of the geology and geography of regions to which they refer. When such work as this is once correctly done it becomes of permanent value to the country and serves a variety of useful purposes for all time to come. In addition to aiding in the development of the mineral resources of Canada reports have contributed such general information of use to the country and observations of value to the scientific world, while the maps have also been of the greatest service from a geographical point of view. In the course of his Geological Surveys, Mr. Murray, I think, surveyed topographically more of the mines, both of Eastern and Western Canada, than any other person. These surveys have necessarily been of very great use not only in the subsequent laying out of land for agricultural and lumbering purposes, but also in the location of roads and even canals, as, for instance, his map of the French River and Lake Nipissing in connection with the Ottawa Ship Canal survey. . . . Whenever these surveys have been checked upon later, they have been found correct. . . ."

It is given to few men, under examination in a witness box, to express so perceptively and so tersely the basic purposes of surveying and mapping, or to pay such an eloquent tribute to a fellow surveyor.

Despite tragic reverses such as the disastrous fires that laid waste the island capital on three occasions over the two-year span of 1816-1817, the population, if not the prosperity, of Newfoundland continued to increase. By 1865 more than 140,000 people were living in the colony. A large measure of representative and responsible government had been achieved. The transition from pounds sterling to the dollar standard had been accomplished. With the increase in population came a steadily mounting demand for qualified surveyors and for much greater activity in land surveying.

The practice of surveying had also undergone a transformation. The profession has progressed beyond the dory compass, picket and fishing line stage. Alexander Murray, in his evidence at the 1869 inquiry, gave fleeting glimpses of some of the advances that had taken place in the field. It had become the custom among surveyors to follow river courses in two canoes. In this manner the line of the rivers could be measured, one canoe travelling ahead of the other, but always in sight. The surveyor was equipped with a Rochon micrometer telescope for measuring distances and a prismatic compass for taking bearings while afloat. One canoe carried a pole on which painted disks served as observation targets. Each river became a base for survey operations on both sides of it. The compass gradually gave way to the theodolite worked "upon a limb" and whenever possible the country was surveyed by the triangulation method, using either a theodolite or sextant. Astronomical observations were taken frequently to establish latitude and the extent of compass variation.

In commenting upon the mode of travel adopted by surveyors in Newfoundland, Murray admitted that a small coasting vessel could serve conveniently to transport a survey party from one part of the island to another but he pointed out that "accommodation of this sort necessarily involves great additional expense and in many parts coast sections are inaccurate for measuring stratographical detail". Murray was convinced that the system of sectional surveys made by following main watercourses was by far the most practical, if not the only method by which adequate knowledge of the geology or geography of Newfoundland could be acquired systematically and reliably.

In Murray's time surveying costs in Newfoundland were considerably in excess of those prevailing in Canada because of much higher costs of provisions and the substantially higher cost of labor during the fishing season. A rough estimate of a geological field party's basic expenditures was made by Murray and contained the following items and costs:

Purchase of locally made canoe	£ 5	
Purchase of a new tent	£ 5	
Hire of 4 men for 4 months	£120	
4 barrels of flour	£ 7	4s.
2 barrels of pork	£ 12	
100 pounds of bacon	£ 5	
Tea, sugar and groceries	£ 20	
Hammers, chisels, etc.	£ 5	
Contingencies	£ 50	
Assistant for 3 months	£ 30	
Total	£259	4s.

To complete a survey on the basis of any lesser expenditure would involve either having the work less efficiently done or providing extra funds out of the party chief's own pocket. This would not include such subsequent steps as the production and publication of a general map with accompanying sections and written descriptions essential in any genuine effort to do justice to the area surveyed and to make the work done fully effective.

This section has dealt mainly with land surveying on the island of Newfoundland. The story of marine surveying in Newfoundland's waters is another story, already partly told in this volume. At the midway mark in the 19th century the department of government responsible for the administration of Crown Lands in Newfoundland was styled the Surveyor General's Department. By 1856 a total of 75 grants of such lands, amounting in all to 1,000 acres, were issued for settlement purposes. In 1865 alone the number of such grants issued totalled 105. Surveys of Crown Lands for the purpose of giving title to purchasers were carried out by deputy surveyors appointed by the Surveyor General. The 20-year period, 1840 to 1860, was marked first by the passing of a bill regulating the sale of Crown Lands (1843), then by a series of amendments to the Crown Lands Act over a number of years which, in turn, led to the major consolidation of 1884. In 1873 an Act to establish homestead law in the colony was passed.

Cormack, Jukes and Murray left the indelible imprint of their resourcefulness, knowledge and dedication not only upon the record of early surveying and mapping in Newfoundland but on the life and progress of its inhabitants. Before their surveys the interior of the island was unknown and the value of its mineral, timber and agricultural resources unsuspected. At the outset Murray's annual geological reports were received with general incredulity. Then the pendulum of opinion swung in the opposite direction and a mania for mining and prospecting flared up. Copper in large quantities was successfully mined, lumbering operations were commenced and promising farmlands were disclosed around Bay St. George and in the valleys of the Humber, Exploits and Gander rivers. For the first time it dawned on the people of Newfoundland and the world that the island would not continue to be completely dependent upon its fisheries.

Following in the venturesome footsteps of these three great pioneers came James Patrick Howley of St. John's, who gave 40 active, highly useful years to the advancement of the cause that his distinguished predecessors had done so much to promote. Each of these four outstanding men realized, in the high tradition of the profession, that his contribution to the task of measuring and reporting the physical assets of the country was but one more pace forward in the continuing development of the land and of its exceptional people.

13

EARLY PROBERS OF CANADA'S SEAS AND GREAT LAKES

For more than three hundred years (1580-1880) Englishmen were active in the exploration, surveying and mapping of Canada's northern waters and the eastern approaches to them. Up until the defeat of the Spanish Armada (1588) England appeared indifferent both to the study and application of scientific principles in the construction of marine charts. The convergence of meridians, for example, was ignored. Marine cartography, in fact, was not practised in England until the 16th century, although about 1510 a fair number of crude English charts came into circulation. It was not until the latter years of the reign of Henry VIII (1509-1547) that a solid base was laid for the craft of chart construction in England. Italy, Spain, France, Portugal and the Low Countries were far ahead of England in this respect. As late as the early 17th century the Dutch House of Blaeu was the world's leading publisher of marine charts.

Henry VIII perceived the need and envisioned the possibilities for the establishment of such a craft in England. He induced the Dieppe-born Jean Rotz to come to England and, in effect, made him a royal hydrographer in 1542. Rotz quickly justified the King's faith in him by preparing, in that same year, an authoritative book on hydrography that included a set of charts incorporating the latest French discoveries in America.[1] But the principal factor in the growth of English marine cartography was the new zeal displayed for improving the nation's harbors. Yet it was not until 1657, when John Moxon published a *Book of Sea Plats* of European coasts, that England made its first substantial bid to break the Dutch monopoly in this important realm.[2]

Richard Lee, in 1533, was listed in Henry's army muster roll as a surveyor entitled to four soldier-assistants. He was a pioneer in the task of charting England's coasts. By 1540 Lee had acquired the imposing but somewhat unofficial title of Surveyor of the King's Works at Calais. John Rogers and Richard Popinjay succeeded Lee in the post of Royal Surveyor, as the post came to be known. Instruments in use in marine surveying in those times included cross-staff for angle measurements, wooden quadrant, astrolabe and compass. But none of the early English charts contained information on soundings. Occasionally a manuscript note indicated a general depth likely to be found over an extensive area. Occasionally, also, submerged reefs were shown.

The active interest of Henry VIII bore good fruit. By the middle of Elizabeth's reign (1559-1603) London was developing into an important centre for marine chart production and for the repair of survey and drafting instruments. In 1599 Edward Wright dealt with problems of chart making in his book *Certain Errors in Navigation*. He deplored the plain charts of the day because of their failure to provide sailing course or line of constant bearing, especially in polar or sub-polar latitudes. He compiled and printed a table of meridional parts for every minute of latitude and published a chart of the Northeast Atlantic on the Mercator plan of projection.[3]

In the light of these developments the venturesome probing of Canada's northern waters by English mariners progressed over the 16th, 17th, 18th and 19th centuries. In part this out-reaching was a natural response of a young, dynamic and expanding nation to the challenge of the beckoning unknown, of new territories waiting to be claimed, settled and organized. During this extended period the commercial motive constituted the principal driving force in the promotion of polar exploration. The motive was two-sided. On the one hand it was a search for the Northwest Passage by sea, so that European trade with the Orient could be expedited and stimulated; on the other there was the hope of exploiting the extensive whale and seal resources of the northern waters.

Magellan's significant feat in rounding Cape Horn in 1520 revolutionized the thinking of European geographers of his day. His success confirmed the validity of the round world theory, also that North America was in all likelihood a continent separate from Asia, and that the land mass of the Americas had to be circumvented in some way in order to reach the Orient by water from Europe on any westward course. Sir Humphrey Gilbert in 1576 expressed the general belief of his times concerning such a route:

"I am of the opinion that America by the Northwest will be found favourable to this our enterprise, and am rather imboldened to believe the same, for that I find it not only confirmed by Plato, Aristode and other Phylosophers: but also by all the best modern Geographers . . .[4]

Before the end of the 16th century the search for the Northwest Passage was under way. To Europeans, intent on westward voyaging, North America was not so much a goal as an impediment. The initial discovery voyage of Sir Martin Frobisher (1535-1594), more than a half century after Magellan's signal achievement, stirred deep excitement. He considered that traversing the Passage was "the only thing in the world that was left undone whereby a notable mind might be made famous and fortunate".

On June 7, 1576, the Yorkshire-born Frobisher (he was knighted in 1588) sailed with a fleet of three vessels, the *Gabriel* (25 tons), the *Michael* (20 tons) and a 10-ton pinnace. The latter was lost en route and the *Michael* was abandoned. On the *Gabriel* Frobisher sighted the Labrador coast on July 28 and then sailed into what is now known as Frobisher Bay. Understandably, in view of the elongated lines of the bay, he believed that he had actually entered the Northwest Passage.

A manuscript map of the North Atlantic area, including parts of Baffin Island and Labrador, was completed by June, 1576, by W. Bourough for the use of Frobisher on his first voyage, probably, as Miller Christy puts it "not as a guide for Frobisher when upon his voyage, but as a semi-blank chart upon which he might plot out the lands discovered or visited . . ."

Two subsequent voyages made by Frobisher, one in the summer of 1577 and the other a year later, were made mainly to carry back to England what he thought was gold-bearing ore but which turned out to be iron pyrites. On the second voyage he landed on Hall Island, on the highest point of which Frobisher "made a cross of stone, sounded a trumpet and said certain prayers . . . honoured the place by the name of Mount Warwick".[5]

In 1578 Frobisher, having been made Admiral of a fleet of 15 ships, landed in the south of Greenland after finding the mouth of Frobisher Bay ice-choked. He named this part of Greenland "West England". Returning later to Frobisher Bay he sailed part way up the strait later explored by Henry Hudson and now known by his name.[6] As an outcome of these voyages England made her first original contribution to the cartography of the New World. The world map and map of Frobisher's Straits were the first to show, with reasonable accuracy, the eastern approaches to Canadian Arctic waters. As T. E. Layng has pointed out, these maps, which appeared in George Best's *A True Discourse* (1578), were probably drawn by James Beare, principal surveyor to the expedition.[7]

John Davis (1550-1605), who followed Frobisher's discovery trail, was born at Sandridge, England: "Here was born that excellent pilot and skilful navigator and fortunate discoverer of unknown countries — John Davis". On January 24, 1583, Dr. John Dee, Adrian Gilbert and John Davis waited upon Mr. Secretary Walsingham (later Sir Francis) "and made Mr. Secretary privy of the Northwest Passage and all charts and rutters* were agreed upon in generall."[8]

As a result of this momentous visit Letters Patent from the Queen were issued to Davis granting "a right to search passages by the North, Northeast and Northwest, to China". Accordingly Davis sailed in command of two vessels *Sunneshine* and *Mooneshine* in 1585. The expenses of this voyage were defrayed by "divers worshipful merchants of London and of the West Country". At this time Davis was not only a sailor but, in a sense, a surveyor. In addition to his invention of the Davis (wooden) quadrant, there is the record of his accomplishments when his vessels, on that first outward voyage, were delayed by bad weather near the Scilly Isles. He visited by boat some of the islands of the group and "did plotte out and describe the situation of all the Islands, rockes and harboroughs, to the exact use of Navigation, with lynes and scale thereunto convenient". On July 20 he sighted the east coast of Greenland, sailed across what is now Davis Strait, proceeding as far north as latitude 66 degrees 40 minutes, along Baffin Island and naming such places as Mount Raleigh, Cape Walsingham and Gilbert Sound. Davis returned to Dartmouth on September 30, 1585.

The second Davis voyage extended from May 7 to October 6, 1586. He sailed from Dartmouth with the *Mermaiyde* (120 tons), *Sunneshine* (60 tons), *Mooneshine* (35 tons) and *North Starre*, a 'pynace' of 10 tons. This latter craft was used for penetrating bays and sounds. His third and final voyage, May 19 to September 15, 1587, was also from Dartmouth with the *Elizabeth* and *Sunneshine*, also the *Ellen*, a pinnace. He sailed along the west coast of Greenland to latitude 72 degrees 12 minutes to Cum-

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*Portolan sailing directions were known to the French as *Routier* and this word became corrupted by usage into the English term *Rutter*.

berland Sound and gave the cape at the entrance to Ungava Bay and Hudson Strait the name of Chidley, honoring "the Worshipfull Mr. John Chidley of Chidley, in the countie of Devon". Chidley had promoted and commanded an expedition to the South Seas by way of the Strait of Magellan.

Davis returned to Dartmouth "giving thanks to God for our safe arrival". He endeavored to reconcile his discoveries with those of Frobisher and, if he could, with the venerable, misleading but still esteemed Zeno map. Unfortunately the large-scale map prepared by Davis has been lost. We possess today only the results as delineated by Davis himself on the Molyneux globe and in the New Map of the World, prepared under the supervision of Mr. Wright. On this "new map" the Davis discoveries are shown as precisely as on the globe.

Parsons and Morris have summed up the transaction in this way: "The compilation of the 1600 chart would seem to fall in this order: Wright transferred the facts and details from Molineaux's globe to his own chart, and Davis and Hakluyt assisted in recording the latest discoveries. This was the first world chart to be published in England, and the passage in *Twelfth Night* . . . 'He does smile his face into more lines than is in the new map with the augmentation of the Indies'... is now generally believed to be a reference to this map . . ."[9]

The lengthy and rather grandiose title of the "New Map" is quaint and revealing: "Thou has here, gentle reader, a true hydrographical description of so much of the world as has been hitherto discovered and is come to our knowledge, which we have in such sort performed, y^{t} all places herein set down have the same position and distances that they have on the globe, being therein placed in the same longitudes and latitudes which they have in this chart which, by the ordinary sea chart, can in no wise be performed".

The restless, roving spirit of Davis turned next to somewhat warmer seas. He discovered the Falkland Islands in 1592, thirteen years before his death at the hands of Japanese pirates near Singapore. Davis was the author of a book on navigation, published in 1594, titled, *The Seaman's Secrets*. He also wrote *The World's Hydrographical Description*, published in 1595.[10]

Though John Davis was unsuccessful in the main quest of his life he managed to add immensely to the knowledge of Canadian Arctic waters. One of the most able of Elizabethan sea captains, Davis was outstanding among early explorers of Canada's north.

The story of Henry Hudson is well known. His heroism and navigational skill linked with a questing mind and spirit are commemorated in the name of the immense Canadian bay in which he met tragic death. As commander of the 55-ton ship *Discovery* he came upon the strait that also bears his name, while on his voyage of 1610. Searching patiently for the passage that had eluded Frobisher and Davis, he penetrated as far south as James Bay. After wintering on the shores of Hudson Bay he began to encounter disaffection among his crew. Most of his men mutinied in the spring of 1611. Henry Hudson, his son John and seven loyal crewmen were cast adrift in an open boat to meet certain death from cold, hunger and exhaustion.

In 1612 Sir Thomas Button, commanding the *Resolution* and Hudson's old ship, *Discovery*, followed Henry Hudson's track to Southampton Island, thence westerly to the mainland coast of the bay at 60 degrees 40 minutes. Button, the first white man to set foot on the soil of what is now Manitoba, wintered at the mouth of a large river that he named the Nelson, after a sailing master of his acquaintance. In 1613 he sailed again to Southampton Island and named one of its large embayments, Bay of God's

Mercy. On his homeward voyage, just five years after the founding of Quebec, he discovered a small group of islands near Cape Chidley. Somehow missed by Henry Hudson, the group now bears the name of the man who so soon after the ill-fated venture of father and son, followed in their course.

Robert Bylot, mate of Hudson's *Discovery* and the mariner who returned that ship to England, made a voyage in the vessel in 1616 with a pilot named William Baffin. In a number of ways this voyage was the most notable of the ventures into the Arctic during the 16th and 17th centuries. Baffin, on this trip, completely delineated the shores of Baffin Bay and reached Northumberland Island, the most northerly point reached by any explorer until the 19th century when John Ross retraced Baffin's course of some 200 years earlier.

Baffin mapped various sounds and islands on the famous 1616 voyage. He deposited his chart with the historian Samuel Purchas, along with his ship's log. The map, however, was regarded by Purchas as expendable because of its awkward size and cost. In any event, the map was lost. Baffin and Bylot were the first explorers to land on any of the Queen Elizabeth Islands as these are known today. The event took place on either Devon, Coburg or Ellesmere Island in July, 1616. One of the largest islands in the world, Baffin Island, preserves the name and fame of this courageous English navigator and mapper. Two centuries later John Ross was much impressed by the accuracy of Baffin's observed latitudes. At the time of his discoveries, however, Europeans generally disbelieved Baffin's description of the vast bay named after him. He remained discredited until the Ross vindication of 1818.

It would be well at this juncture to consider the grave difficulties attending the writing of ship's logs on any of the tiny Elizabethan ocean-going vessels equipped with such primitive and confined accommodations as to allow little human comfort. In such a log would be set down purely factual information of courses, events and distances travelled as well as weather reports. But occasionally there would also be references to the commander's philosophy of life and exploration together with unabashed ventures into poetry and fantasy.

The distinguished Danish marine pioneer, Jens Munk during 1619 and 1620, Luke Foxe aboard his 70-ton pinnace, *Charles* in 1631 and Thomas James in 1631 and 1632 on the *Henrietta Maria*, all probed Hudson Bay in the 17th century hoping to find that this vast opening into the heart of the continent was the true passage to the Pacific. Their efforts were in vain. Capt. Foxe, as he proceeded along the western shore of the bay, sent out landing parties from time to time. He gave signs, in his diary, of being a natural-born surveyor. For example, this entry for August 3rd:

". . . the land lowe, but now and then a Sandie knowle or downe would appeare, much like the coast of Holland and Flanders: wee made way S.W. and by W. 10 leag., and divers times see dry shelves betweene us and the shoare. The Latit. was 60 d. 22m."[11]

In the 18th century examination of the Hudson Bay shoreline was continued by Knight, Scroggs, Middleton and others. But, in general, by 1650 the possibility that any one of the three main water entrances into the North American continent, (Hudson Bay, the St. Lawrence or Hudson rivers), could be a Northwest Passage to the Orient, had been effectively demolished. The first entranceway to be probed, the St. Lawrence Gulf and River had been found by Cartier to be but the drainage system of a group of very large inland lakes, rather than a transcontinental breach. Hudson Bay had proved to be unfruitful as a short cut to China but it required another century of investigation to demonstrate to the world that none of the principal rivers flowing into the bay led to the Pacific. Baffin Bay, far to the north, also appeared to be an ice-bound dead end. Champlain had proved that the Great Lakes of the interior were bodies of "sweet water" rather than part of any western ocean. He was satisfied also that at least one thousand miles of land separated those lakes from the Pacific. In fact, as geographical knowledge of North America kept increasing during the 17th century, the location of the western ocean kept fading, farther and farther away. The wide straits or water passages severing the continent, as shown on many maps of North America in the 16th century, were the result of lively imaginations rather than of any search for solid facts.

In 1745 the British government provided by legislation for a cash award for special achievement in Arctic search and research. The sum of £20,000 was offered in that year "to such person or persons, subjects of His Majesty, as shall discover a Northwest Passage through Hudson's Straits to the western and southern oceans of America". In the meantime knowledge of the theory and practice of surveying and mapping was growing apace in Europe. But it was not until the last decade of the 18th century that England matched its progress in land surveying, including the establishment of its notable Ordnance Survey in 1791 by the founding of the Hydrographic Office of the Admiralty on August 12, 1795.

During the period of the Napoleonic wars interest in the Canadian Arctic waned. But in the post-war period two polar-minded men of considerable national stature in England gave much-needed leadership, namely, Sir John Barrow, Secretary of the Admiralty and the aging man of vision, Sir Joseph Banks, president of the Royal Society. The good works of both are fittingly perpetuated in the names of prominent geographical features of our Arctic region. The legislative inducement of 1745 was repeated in 1818 with the addition of £5,000 for the attainment by any explorer of latitude 89 degrees North. Under the authority of the Commissioners of Longitude a scale of prize awards was created for the crossing of various parallels of high latitude. It was this system of official awards that sparked the liveliest and most productive half-century of Arctic discovery.

Lieut. William Edward Parry (1790-1855), knighted in 1829, conducted the first of several of his expeditions in 1819—extending into 1820—with the 375-ton *Hecla* and 180-ton *Griper*. He laid formal claim to the award made available for crossing the meridian of 110 degrees west of Greenwich in latitude 74 degrees 44 minutes 20 seconds North. He stated that September 6, 1819, was the date of such crossing. The ultimate westing reached by the Parry vessels that season was 112 degrees 51 minutes West. On August 16 of the following year Parry, commanding the *Hecla* and the 377-ton *Fury*, reached the meridian 113 degrees 48 minutes West. Unable, however, to cross the considerable Beaufort Sea to Point Barrow, Alaska, Parry returned to the Thames in mid-November, 1820. Rev. George Fisher was both chaplain and astronomer on this journey. Parry had proved that Lancaster Sound was not an inlet, as John Ross had mistakenly surmised in 1818, but the beginning of what could be a true Northwest Passage.

Parry had achieved an oustanding triumph of northern navigation and survey. He had discovered and named Devon, Cornwallis, Bathurst, Byam Martin and Melville Islands. His own name was later applied, about 1835, to this whole group. He had sailed westward across the top of the continent, over more than 30 degrees of longitude, and carried out surveys calculated to create a geodetic network upon which all later discoveries in the Arctic could be based. He had mapped the north, south and east coasts of Melville Island, the south coasts of Devon, Cornwallis and Bathurst Islands as well as the north and east coasts of Somerset Island.

On deposit with the British Admiralty, London, are the results of considerable surveying and mapping accomplished in the Arctic, by-products of official expeditions of those early days. There is, for example, a chart showing the track and discoveries of the Parry expedition of 1819, on that part of the voyage extending from Cape Farewell (at the southern tip of Greenland) to Lancaster Sound; this chart was drawn by Lieut. F. W. Beechey. There is a faint pencil note on the chart stating that it included "the track of H.M. Ship *Hecla*". There are also some unfinished 1819 field sheets indicating Beechey's work on the west coast of Baffin Bay.

In 1820 the name of John Bushnan, R.N., midshipman and assistant surveyor begins to appear in connection with the work of the Parry expedition. There are in the same collection 1820 survey bearings on the west coasts of Baffin Bay and Davis Strait taken by him. Also dated that year is a chart of the Parry discoveries with a pencil note against a representation of part of the south coast of Melville Island: "This coast line not inserted, in hopes of obtaining more accurate angles. W. E. Parry, August 1, 1820". Also there are roughs of survey observations made by Lieut. Beechey. Evidently he performed the survey work of that Parry voyage. In his pencilled notes in the rough of Barrow Strait and Baffin Bay we find the entry: "This coast was surveyed on our passage home. The data for laying it down will be found in my rough surveying book. I had not time to lay it down myself".[12]

On his second expedition (1821-23) Parry reached Foxe Basin. A chart dated 1821 shows the north coast of Hudson Strait and the track of his two vessels, the *Hecla* and *Fury*. This chart was drawn under Parry's "immediate inspection" by John Bushnan. Other charts include Davis Strait (3 sheets), Foxe Channel, Repulse Bay, Lyon Inlet and North Southampton Island. For the third Parry voyage (1824-25) to Prince Regent Inlet, there is a chart of the inlet as re-surveyed at that time, also of Port Bowen as re-surveyed in 1825 on a triangulation scheme.

Parry, who became Admiralty Hydrographer (1825-29), recommended that "ships endeavoring to reach the Pacific by this route should keep, if possible, on the coast of America and the lower in latitude that coast may be found, the more favourable will it prove for that purpose".[13] This observation by Parry set the pattern of marine exploration in the Canadian Arctic for the next quarter-century. Parry was to the Arctic waters of Canada what Cook was to the Pacific, a bold yet sagacious navigator, scientifically trained, and highly esteemed by the men he commanded.

John Ross (1770-1856) was knighted in 1834 in recognition of his Arctic work. He made three separate expeditions. He was appointed in 1818 by the British Admiralty to command a search for the Northwest Passage. His second-in-command in 1818 was Lieut. W. E. Parry, R.N. On that initial voyage Ross missed exceptional opportunities to gain lasting fame when he concluded, without sufficient examination, that Jones, Smith and Lancaster Sounds were inlets, not salt-water corridors from Baffin Bay to the Arctic Ocean. Parry, a year later, reaped the real benefits of the 1818 expedition.

The second John Ross expedition was undertaken in the 150-ton paddle-wheel steamer *Victory** which sailed on May 23, 1829, returning to England in 1833. This voyage was more notable for the information gathered in scientific fields than for geographical discovery. It served to enlarge considerably the area of knowledge on terrestrial magnetism and weather data. An extensive list of latitudes and longitudes was also compiled. Much of the charting of Boothia Peninsula and of King William Island was accomplished on this expedition.

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*The *Victory* was the first steam vessel used by the Admiralty in Canadian Arctic explorations.

On June 2, 1831, James Clark Ross, a nephew of John Ross and a midshipman on this expedition, journeyed on foot 100 miles from the base at Victory Harbor to Cape Adelaide Regina on Boothia Peninsula. There he fixed the geographical point marking the then location of the north magnetic pole at 70 degrees 5 minutes North latitude and meridian 96 degrees 46 minutes West.[14] He took possession of the pole for Great Britain and King William IV and he is probably the only scientist who has stood so near the centre of the magnetic pole zone. The magnetic pole is an area, some 16 miles in diameter, rather than a precise point. Its location is constantly fluctuating and, in addition, the pole has been moving in a rather wobbly but generally northerly direction since its discovery in 1831. From Boothia Peninsula, for instance, this pole has moved about five miles a year to Prince of Wales Island and then, according to a field redetermination party in mid-1962, it is reported to have moved to just off Peddie Bay, Bathurst Island. It was estimated that by 1965 the north magnetic pole would be either just offshore or slightly inland on Bathurst Island. Following the return of John Ross in 1833 the British Admiralty published its *Chart of the North Polar Sea*, by J. Wyld.

The third and final voyage by Sir John Ross was made when he was 73 years old. He sailed in 1850 on the 120-ton schooner *Felix* and his 12-ton yacht *Mary* to participate in the search for the lost Franklin expedition. However, as this venture took Ross only as far as Lancaster Sound it was not especially productive in terms of geographical discovery. Sir John seemed fated to attract controversy and he took part in numerous correspondence battles, both public and private. But Ross was eminently successful in guarding well the health and welfare of his crews at a time when scurvy was a constant menace. He lost very few men.

In 1848 Sir James Clark Ross was appointed to be in charge of one of three expeditions despatched by the British government to search for the missing Sir John Franklin. It was an unsuccessful foray but two men who later gained wide recognition in polar exploration, Sir R. J. le M. M'Clure and Sir F. L. M'Clintock, were introduced to the rigors of the Arctic on this voyage.[15]

By the time of the third Franklin expedition (1845) the story of the hunt for the all-important "passage" had been one of frustrating failure, despite valiant attempts by way of Melville Sound, Prince Regent Inlet, Fury and Hecla Strait and by Bering Strait. The general outline of the north and south coasts along Lancaster Sound and Barrow Strait were fairly well known, as was the mainland Arctic coast of Canada.

Sir John Franklin had made sorties into Canada's Arctic in 1819 to 1822, accompanied by two surveyors — Robert Hood and George Back (the latter being knighted in 1839). On Franklin's second overland expedition, 1825 to 1827, Back and E. N. Kendall were surveyors.

An extract from a Franklin report for Thursday, December 22, 1825, describes surveying activity, likely in the vicinity of Great Bear Lake:

"The sun rose this morning at 10 hr. 24 minutes, thirteen minutes earlier than its appearance was expected from calculation, owing to the great refraction. Mr. Kendall and I measured its meridional altitude from the lake with two instruments, the one bringing its upper limb to the top of the land 4 miles distant, the elevation of which had been ascertained to be 8 minutes, and the other, to its base, the depression of which was 2 minutes. The mean of both these observations, corrected for refraction by the tables in the Nautical Almanack, gave a result of 65° 11′ 56″ North, which latitude exactly corresponds with the best observations made in the previous autumn . . . At 8 hr. 30 minutes, p.m., a halo was observed, whose radius measured 28° 40′ from the moon; and at an equal altitude with the latter body there were two paraselenae which as well as the moon were intersected by a luminous circle, having the zenith for its centre, and a diameter of 94° 15′. The length of our shortest day did not exceed 5 hours, but the long nights were enlivened by the most brilliant moonlight and we had frequent and very fine appearances of the Aurora Borealis . . . on all these occasions the disturbed motions of the magnetic needle were very remarkable, and a most careful series of observations convinced the party that they had a close connection with the direction of the beams of light of which the aurora was composed. My observations also led me to conclude that the deviations of the needle were, in a certain degree, connected with the changes in the weather. Previous to a gale or snowstorm deviations were always considerable but during a gale the needle almost invariably remained stationary".[16]

On Wednesday, May 24, 1826, Franklin describes an ordeal familiar to most explorers of Canadian territory:

"On the 24th the musquitoes appeared, feeble at first but, after a few days, they became vigorous and tormenting . . ." and, again on June 28, "When we landed to sup the musquitoes beset us so furiously that we hastily despatched the men and re-embarked . . . They continued, however, to pursue us and deprived us of all rest".

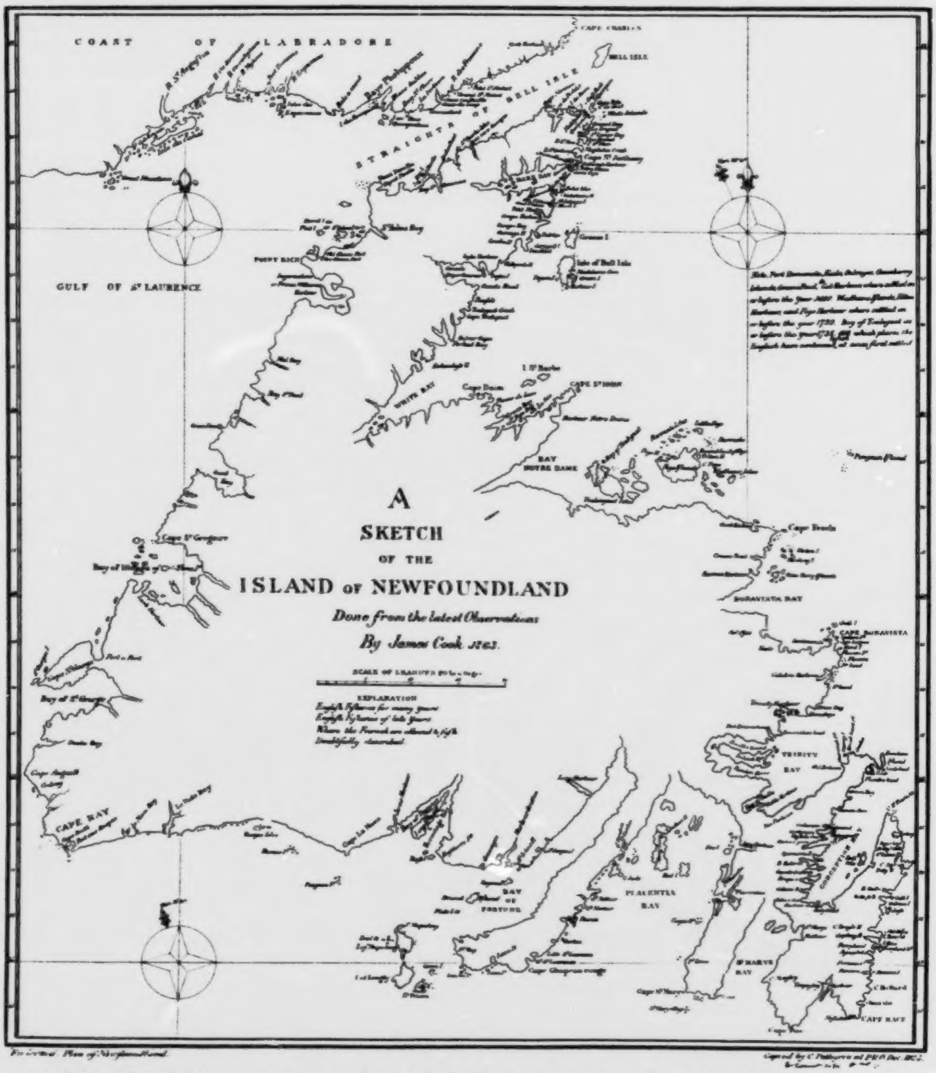
In 1845, with two vessels, the 370-ton *Erebus* and the 340-ton *Terror*, Sir John sailed on explicit instructions from the Admiralty concerning the course he should follow in order to find and to navigate the Northwest Passage. This venture ended in tragedy but, indirectly, the mysterious disappearance of Franklin and his 129 officers and men provided a powerful impetus to polar explorations at a time when it might have lapsed entirely.

The principal search extended over more than a decade. The M'Clintock expedition, financed by Lady Franklin, uncovered sufficient evidence from 1857 to 1859, especially on King William Island, to dispel, along with other findings, much of the dark mystery surrounding the fate of Franklin and his men. The scope and persistence of the numerous expeditions sailing into dangerous and largely unknown waters, has had no parallel in the maritime history of the world. During the decade of search (1849-59) 33 ships wintered in the Canadian Arctic. Hundreds of crewmen and many officers were involved in all these projects and the total cost to the British government amounted to millions of pounds sterling. In addition, very considerable amounts of money were contributed by other nations for the purposes of the search.

One of the charts in the British Admiralty collection showing the Northwest Passage, as travelled in part by H.M. Ship *Investigator* (M'Clure), indicates the coast explored in search of Franklin by (Sir) James Clark Ross, 1848-49; John Richardson, 1848-49; Commander R. J. le M. M'Clure, 1850-54; Capt. Horatio T. Austin, 1850-51; Mr. William Penny, 1850-51; Mr. John Rae, 1851; Mr. William Kennedy, 1852; Capt. (Sir) E. A. Inglefield, 1852-54; (Sir) Edward Belcher, 1852-54. The chart was drawn by W. H. Fawekner.[17] The names that appear on it read as an honor roll of many of those who, as commanders, braved many perils of storm and deep to probe Canada's northern waters in order to solve a double riddle and to make the Arctic safer for future navigation. The end of the Franklin search, as Andrew Taylor has pointed out, was the end of an era of exploration in the Canadian Archipelago. Men were now turning their thoughts from the Northwest Passage to a new goal, the North Pole.[18]

Captain James Cook

When James Cook was appointed naval engineer to Governor Palliser of Newfoundland, early in 1764, he had already gained considerable experience in marine surveying and charting. After Louisbourg he had been carefully coached in these activities by Holland, DesBarres and others. As Master of the *Pembroke* and, subsequently, of the *Northumberland* he had accomplished useful work in the St. Lawrence River and


COAST OF LABRADORE
STRAIGHTS OF BELL ISLE
BELL ISLE
CAPE CHARLES
GULF OF ST LAURENCE
POINT RICH
WHITE BAY
CAPE ST JOHN
BAY NOTRE DAME
Cape Bonavista
BONAVISTA BAY
TRINITY BAY
CAPE RAY
BAY OF FORTUNE
PLACENTIA BAY
ST MARYS BAY
CAPE RACE
A
SKETCH
OF THE
ISLAND OF NEWFOUNDLAND
Done from the latest Observations
By James Cook 1763.
SCALE OF LEAGUES
EXPLANATION

MAP 26. The original is in the Archives of the Admiralty in London, England. Reproduced from a copy in the Public Archives of Canada.

Gulf in 1759 and 1760; in and near Halifax in 1761 and in the Placentia Bay area in 1762. But most of these duties and undertakings had been linked, more or less directly, with military projects. In 1763 he entered a period of what was essentially peacetime employment. In that year he charted the coasts of St. Pierre and Miquelon. His work along Newfoundland and Labrador coasts from 1764 to 1767 has been traced (see Chapter XI). Cook was 39 years of age when he returned in April, 1767, to Newfoundland waters for the last time.

By now, the stars in their courses appeared to be helping to shape Cook's future. Edmund Halley the eminent Astronomer Royal of England, had predicted that a transit of Venus would take place in June, 1769 and that the event could best be observed from a point in the South Seas. Measurements taken at the time of the transit would provide a means of calculating more accurately the distance between earth and sun. Apart from astronomical considerations there was a pressing need to ascertain whether or not a continent existed in the southern hemisphere. If any such new land was found, there would be the opportunity to claim it for Great Britain.

Alexander Dalrymple, the distinguished hydrographer, possessed the seafaring and scientific qualifications essential to lead the expedition to the South Seas. But he was not a naval officer. This lack of status, in the view of the British Admiralty of that day, was regarded as fatal to Dalrymple's prospects of ship command. James Cook, by this time, had built up an imposing reputation as a hydrographic surveyor, chart maker, navigator, planner and administrator. Both the Admiralty and the Royal Society had been favorably impressed by his special abilities at a moment in the world's history when sea-going scientists were rare creatures and in lively demand. It is not too surprising, therefore, that James Cook was selected to take charge of the expedition and of the ship *Endeavor*.

Cook's initial venture (1768-71) was the forerunner of two other momentous voyages of discovery under his command, adventures that would extend, in all, over eleven years until his tragic death in Hawaii early in 1779. After a ten-year interval Cook was fated to work once again along Canadian coasts. It can be said that he commenced and ended his active surveying and charting career in Canada's Atlantic and Pacific waters respectively. It can also be said that he was the only 'hydrographer' who, until quite recent times, practised his profession on all three of Canada's ocean coasts. Known only to a comparatively small group of scientists and naval authorities until his appointment to the *Endeavor* in 1768, this one-time map draftsman rapidly became renowned throughout the world as a finder of new lands and a moulder of the destinies of generations to come. Nearly a century was to elapse, however, before the occupation of Australia and New Zealand and the settlement of British Columbia were to crown the persevering and pioneering exertions of Capt. Cook. Not the least remarkable aspect of his towering achievements was the fact that he crowded so much constructive accomplishment into a lifetime barely exceeding fifty years.

Cook's men were well-trained, subjected to strict discipline and were, on the whole, happy to follow his sensible precepts and inspiring example. At the age of 14, the third son of John Jasper Vancouver and his wife Bridget, was apprenticed to James Cook in 1771, following the explorer's return from his first triumphal voyage to the South Pacific. We may assume that, if the practice of those times was observed in this case, George Vancouver was selected by Cook himself. But the circumstances of the initial meeting remain unknown.

On his initial voyage to the Pacific Cook carried no chronometer but he and his astronomer, Green, had made frequent calculations of lunar distances with the aid of tables just published by Astronomer Royal Nevil Maskelyne. On his second voyage Cook took along astronomers William Wales and William Bayley. His vessels, the *Resolution* and *Adventure*, carried three experimental but rather unsatisfactory chronometers made by Arnold as well as a very reliable instrument made by Kendall from a design by John Harrison. In his Narrative of the first voyage Cook comments that "the commander, first lieutenant and astronomer on board each of the ships, kept, each of them, keys of the boxes which contained the watches and were always to be present at the winding them up and comparing the one with the other. . .".

Before he could become eligible for a commission, young Vancouver was required to serve six years at sea. During Cook's second voyage, which commenced on April 9, 1772, George Vancouver had daily forenoon sessions with his schoolmaster, William Wales, the astronomer, who taught him trigonometry, navigation and the sea sciences. Wales, in fact, was one of the leading astronomers of his era and contributed greatly to the establishment of longitude by mariners. The Norfolk-born student developed swiftly under this unique tutelage. In later years Capt. Vancouver expressed his gratitude by naming a headland on Observatory Inlet, British Columbia, in remembrance of his teacher, Point Wales. . . . "after my much-esteemed friend Mr. Wales of Christ's Hospital; to whose kind instruction, in the early part of my life, I am indebted for the information which enabled me to traverse and delineate these lonely regions".[19]

Prior to the Pacific Ocean ventures by James Cook great unanswered questions of geography and science occupied the minds of men. Did a southern continent actually exist? Would it be possible to find a Pacific entrance to the Northwest Passage? Could scurvy and other diseases be controlled effectively during long voyages? How could meridians of longitude be located with sufficient accuracy to ensure success of such voyages? In the final splendid decade of his life Cook provided satisfactory answers to all of these questions. By reason of the lessons learned by Cook in locating meridians, lessons based on the inventions of clockmakers and the calculations of astronomers, the science of surveying and the art of cartography were substantially advanced.

Cook made wise use of anti-scorbutics and insisted upon his crews combatting scurvy and other deficiency diseases by drinking spruce beer, fruit juices or by eating sauerkraut preparations as well as keeping their quarters aboard scrupulously clean. In addition he obtained fresh provisions for his ships wherever possible. His success in controlling such devastating illnesses may well have been his greatest contribution to the welfare of mankind. It is reported that on one very prolonged voyage an English commander, before Cook's experiments, lost 626 out of 961 men on three ships of his fleet!

The main objective of Cook's third and final voyage (1776-79) was to search for the Northwest Passage. The £20,000 reward posted by Parliament in 1745 for success in this quest, still stood. In July, 1776, Capt. Cook (he had been promoted to Post Captain in the interval between his second and third voyages) left Plymouth in command of the *Resolution* and *Discovery*, sailing independently towards the Cape of Good Hope. On his way out of Plymouth harbor he observed, with sadness, British troop ships carrying Hessian soldiers to military campaigns in North America, the continent to which he himself was now headed, intent upon an entirely peaceful and constructive mission.

It was after February 2, 1778, when he left Hawaii, that Capt. Cook entered upon the last great marine survey of his illustrious career, namely, the examination of the Pacific Coast of North America above latitude 45 degrees North. He endured the onslaught of fierce storms and during March was twice swept away from the coast. In

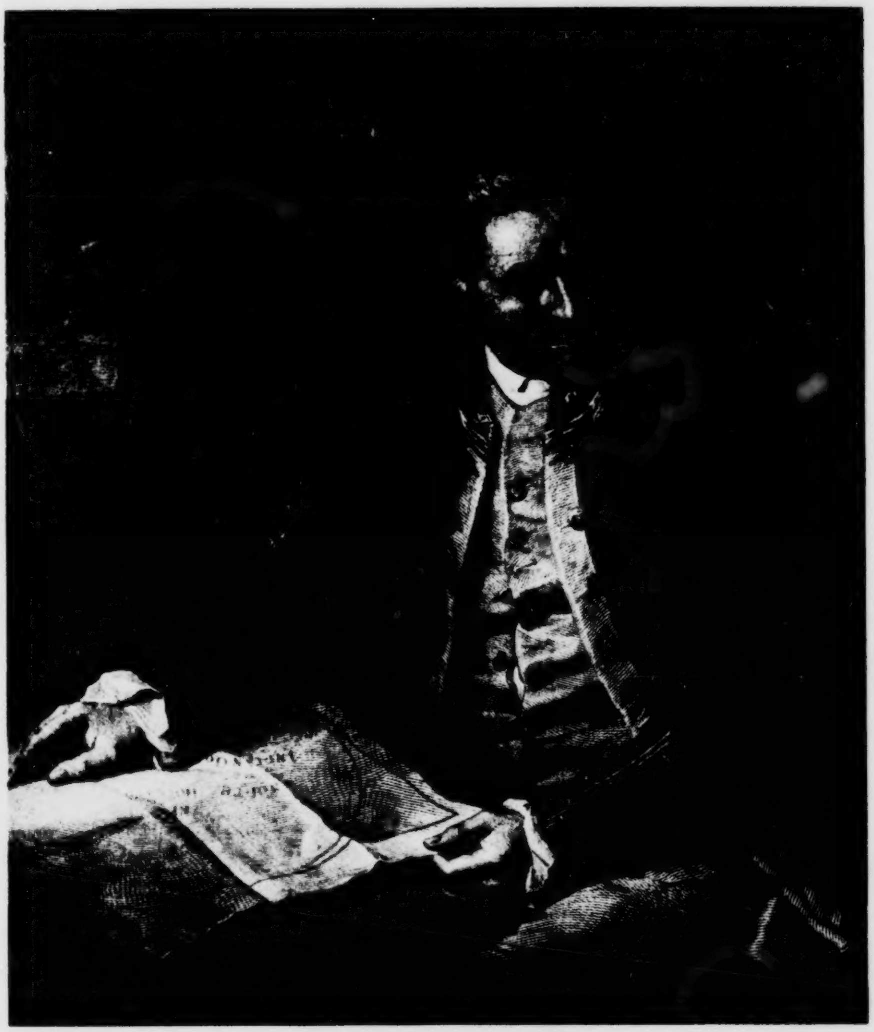


FIGURE 16. Captain James Cook, R.N.

these gales he missed the opening of Juan de Fuca Strait: "It is in this very latitude (of Cape Flattery) where we now were that geographers have placed the pretended Strait of Juan de Fuca. But we saw nothing like it; nor is there the least probability that ever any such thing existed"![20]

At the end of March, 1778, Cook made landfall at Nootka Sound on an island to become known by the name of one of his midshipmen, George Vancouver. In his Narrative is the following entry for April 26: "The inlet I honored with the name of

King George's Sound but its name with the natives is Nootka . . . the Clemate is . . . infinitely milder than on the East coast of America under the same parallel of latitude . . .". On that same day Cook sailed towards Alaska and touched at no other Canadian point. But his visit served to establish Britain's claim to this part of North America and it supplied deep-sea mariners with navigational information they required. Further north he investigated the imposing water entrance now known as Cook's Inlet, Alaska. His Narrative for June 1, 1778: "At 2 o'clock in the Morning the Master returned and reported that he had found the Inlet or rather, river, contracted to the breadth of one league by low land on each side, through which it took a northerly direction . . . all hopes of a Passage was now given up . . . If the discovery of this River should prove of use, either to the present or future ages, the time spent in exploring it ought to be the less regretted, but to us who had a much greater object in View, it was an essential loss; the season was advancing apace, we knew not how far we might have to proceed to the South and we were now convinced that the Continent extended farther to the west than from the modern Charts we had reason to expect and made a passage into Baffin or Hudson bays far less probable, or at least made it of greater extent. But if I had not examined this place it would have been concluded, nay, asserted that it communicated with the Sea to the North, or with one of these bays to the East. In the afternoon I sent Mr. King again with two armed boats, with orders to . . . display the flag, take possession of the Country and River in his Majesty's name".

It is a matter of some interest to Canadians that Capt. William "Breadfruit" Bligh (1754-1817) was Master of the *Resolution* during the 1778 survey season when Capt. Cook visited Canada's Pacific Coast.* A manuscript chart showing Cook's discoveries between Latitudes 42 degrees North and 61 degrees 45 minutes North, drawn by William Bligh, is preserved in the records of the Hydrographic Department, British Admiralty.[21] The lack of mention of Bligh's name in the official Narrative of the third voyage is puzzling, in the light of existing evidence of his substantial contribution to its success in the realm of surveys and chart construction. It is now believed that rough and ready Bligh (with his undoubted talent for making enemies) and class-conscious King disliked each other to the point of bitter hostility. It would appear that King, in his writings, deliberately and grossly neglected Bligh's important part. On his own copy of the Narrative of the third voyage of Capt. Cook, Bligh's marginal notes, in tenor and substance, support this belief. For example Bligh states bluntly: "most of the maps and charts in this publication are from the original drawings of Lieut. Henry Roberts, so it is stated—he did no more than copy the original ones from Capt. Cook, who, besides myself, was the only person who surveyed and laid the coast down, in the *Resolution*. Every Plan and Chart from the time of Cook's death, are exact copies of my works".[22]

Eight years after Capt. Cook's untimely death, Capt. Bligh was sent to the Pacific in command of the *Bounty* for the purpose of transporting and transplanting the breadfruit plant from South Sea islands to the West Indies. It was during the course of this mission that the well-publicized mutiny took place, following which Bligh and some companions made their historic journey to Timor in an open boat, a triumph of navigation and human endurance.

Some 25 years before Cook sailed into the North Pacific, the Russian explorers, Bering and Cherekov, had examined the Alaskan coast as far south as the Queen Charlotte Islands. But their survey had not been exhaustive. Cook, for his part,

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*Bligh Island, entrance to Nootka Sound, is named for the famous captain.

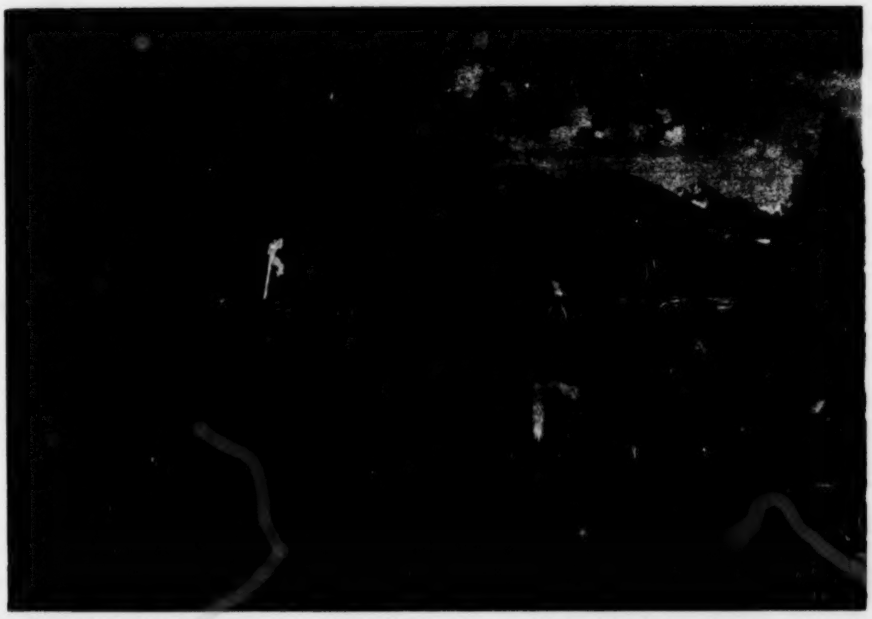


FIGURE 17. Captain Cook on Vancouver Island. Nootka Sound was the base for Captain Cook's search for the North West Passage with the *Resolution* and *Discovery*, 1778.

continued northward through Bering Sea and Strait. He proceeded along Alaska's Arctic coast as far as Icy Cape where, despite repeated efforts, his forward progress was blocked by pack ice. At this most northerly point of all his voyaging (70 degrees 29 minutes North) Cook was almost as near to the North Pole as he had been to the South Pole on his second voyage of discovery. On his return to wintering quarters in the south, Cook passed along the Pacific Coast of Siberia. He reached Kealakekua Bay in the Hawaiian Islands on January 17, 1779. In a brief encounter with natives on the shore of the bay on the morning of February 14, James Cook was killed and his body savagely dismembered.

In the melancholy aftermath of this disaster the *Resolution*, accompanied by the *Discovery*, ventured north again on a further gallant but unsuccessful effort to find the elusive passage by searching Russian and Alaskan waters. The vessels arrived back in England on October 4, 1780, more than 50 months after leaving Plymouth. Only one man out of 118 had been lost in more than 1,500 days of hazardous missions.

Throughout the whole of a vast domain washed by the waters of the Pacific Ocean, millions of English-speaking people living today owe their economic opportunities and advantages, in great measure, to the exertions and sagacity of this remarkable and celebrated man. Had he returned safely to England, Cook would almost certainly have received a baronetcy from a grateful monarch acting on behalf of a nation proud to salute his memory. As Christopher Lloyd has pointed out so perceptively, "the character of Capt. Cook is summed up in the names of his ships, *Resolution*, *Endeavor*, *Adventure* and *Discovery*".

James Cook bequeathed to mankind a precious legacy of outline maps of the entire

Pacific basin, maps that were unprecedented, at the time of their issue, in scope and general value.[23] He left another legacy of inestimable worth. Cook's third voyage took place during the period when England was heavily engaged in hostilities and when her first great empire was staggering under the grievous loss of her 13 American colonies. The Declaration of Independence was signed at Philadelphia just a few days before Cook embarked on his final venture. During that same period of convulsion and loss in the Atlantic area Cook was at work laying lasting foundations of a significant extension of empire in the Pacific.

Cook deserves immortality in the gallery of benefactors of humanity because of the high quality and immense number of pioneer surveys and charts supervised by him. More than a decade was to pass before his one-time apprentice seaman and midshipman, George Vancouver, would resume in Canada's Pacific waters the impressive hydrographic survey commenced so dauntlessly by Capt. Cook.

Captain George Vancouver

Immediately following the violent episode at Kealakekua Bay Lieut. King and Midshipman Vancouver (promoted to a lieutenancy on October 19, 1780) were sent to locate the remains of Capt. Cook. The few recovered parts of his body were buried ceremoniously at sea. This gruesome experience failed to alter young Vancouver's determination to fit himself for the task of carrying on important marine survey work, if ever the opportunity offered. During the decade following his return to England on the *Resolution*, Lieut. Vancouver served on naval vessels in the Caribbean area. Even with his undoubted talents, ambitions and experience employment was not continuous for him. For instance, there was the worrisome 18-month period extending from 1783 into the following year when he was on the inactive list at half-pay. But all the while world events and forces were constructing a prominent stage on which the restless young naval officer would soon play a formidable and memorable role.

Nootka Sound, not by any means a place name well known to Canadians of the 20th century, was much in the international limelight in the closing years of the 19th. Spanish and English spheres of influence were persistently overlapping along the Pacific shores of North America. The pressures resulting from the increasing competition of these giant rivals were concentrated at Nootka Sound in 1789 when the Spaniard, Martinez, seized English ships harboring there, as well as other property. The whole European scene was darkened by the grim threat of war. Armed conflict, in fact, was only averted by an agreement to sign the Nootka Sound Convention at Madrid in 1790. By the terms of this 8-article treaty Spain promised restoration of buildings and land seized, and also granted reparations. Opportunity to trade with the natives of the region was guaranteed to the nationals of both countries. For the first time since the age of Columbus, Spain had formally conceded that another nation possessed rights in the Pacific area. In order to receive, in a formal ceremony, Spain's offer of restitution England decided to send a representative naval officer to Nootka Sound. George Vancouver was the officer chosen for this mission, mainly on the recommendation of Sir Alan Gardiner, under whom he had served during his years in the Caribbean. Lieut. Vancouver was placed in command of an expedition which, apart from its diplomatic character, was to be a voyage of discovery in the North Pacific. His instructions were to sail "... Principally with a View to Ascertaining the Existence of Any Navigable Communication Between the North Pacific and North Atlantic Oceans". It was to be a probe not only for a Northwest Passage but for a British Passage. Vancouver com-

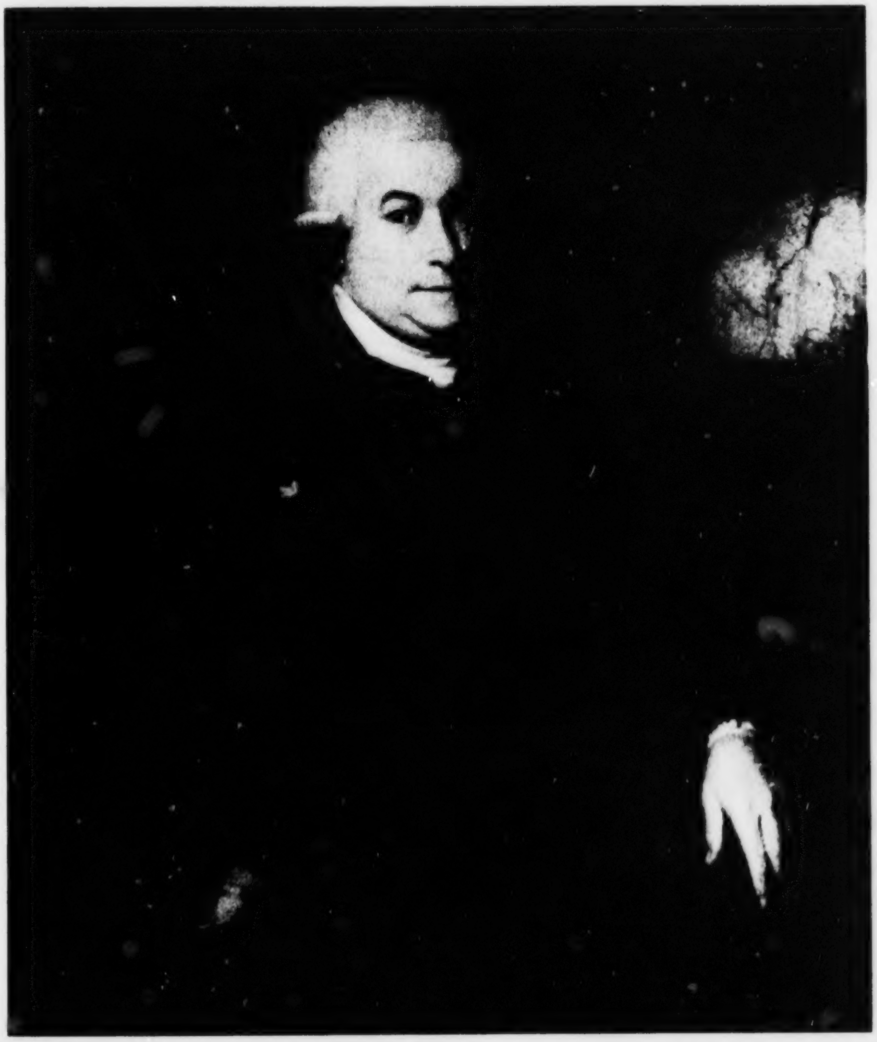


FIGURE 18. Captain George Vancouver, R.N.

manded the *Discovery* (not the same vessel used by Cook) and an armed tender, the 130-ton *Chatham.* He placed Lieut. William Broughton in charge of the latter.

Vancouver was expected to examine the Pacific Coast of North America from Latitude 30 degrees North to Latitude 60 degrees North (in the vicinity of what is now Cook Inlet). "The survey should be so conducted", his orders ran, "as not only to ascertain the general line of the sea coast but also the direction and extent of all such considerable inlets whether made by arms of the sea, or by the mouths of large rivers. . . ."[24]

The two vessels sailed from Falmouth on April 1, 1791. They did not return until nearly 5 years later. At the outset Vancouver was not enthusiastic over having an astronomer aboard and sailed without one. But he speedily changed his mind and sent a message to home authorities asking that a scientist be sent to the Pacific on the next supply ship, equipped with astronomical instruments. Apparently the latter reached Canadian shores but not the former. Mr. Gooch, the astronomer, along with several crewmen, met death at the hands of natives on a South Pacific island. An astronomical clock, three timekeepers and other equipment sent by the Board of Longitude with the astronomer, were set up as a small observatory on the shores of Nootka Sound in 1792.

These instruments represented assets in addition to twelve sextants placed on the vessels leaving England and described in Vancouver's Narrative as having been made "by such eminent [London] instrument makers as Ramsden, Dolland, Troughton, Adams and Gilbert" though he adds, "the greater number were made by Ramsden". He proceeds to comment on their performance, "They all agreed exceedingly well together and their mean result showed the longitude to be 16 degrees 21 minutes 32 seconds, the chronometer made the longitude to be 16 degrees 31 minutes 15 seconds West, and as there could be no doubt of the latter being nearer the truth, the result of the lunar observations by the several sextants, appeared to be 9 minutes 43 seconds too far to the eastward. On the other side of the Moon, my lunar observations were 15 minutes to the west of the true, or nearly the true longitude, as was proved on our making the Madeiras. This evinces the accuracy with which these observations, in general, are capable of being made with good instruments by a careful observer".[25]

Before Vancouver sailed from England on this voyage there was available to him John H. Moore's book, *The Practical Navigator,* published in 1784. Among Moore's instructions in regard to the surveying procedure of a ship in a position to observe a seacoast, were these rules, "take with the Azimuth Compass, the Bearings, in Degrees, of such Points of the Coast as form the most material Projections or Hollows; write down these Bearings and make a rough Sketch of the Coasts . . . then let the Ship run in a direct line, which must be carefully measured by the Log or otherwise, for 1, 2 or 3 miles. . .". Four men were required to participate in this survey operation. One took compass bearings — a sextant could also be used for measuring angles between headlands — and this observer made adjustments for magnetic variations. A second man made calculations of the speed of the ship and recorded the information. A third man supervised leadline soundings and a fourth plotted the position of the ship as well as fixing the positions of headlands in relation to the track of the ship. Three weeks before their North American landfall Vancouver and his officers took 85 separate sets of lunar observations to establish an accurate starting point for the survey.

Before proceeding to the North Pacific, Vancouver carried out his plan to explore and survey the southwest coast of Australia, then mainly a blank on the map of the world. By January, 1792, his ships had sailed from Tahiti to Hawaii. Here Vancouver's health was obviously deteriorating. But little more than a year after his departure from Falmouth, the *Discovery,* on April 18, 1792, sighted the coast of New Albion, the name Sir Francis Drake had bestowed on what is now the Pacific Northwest region of the United States. This was at a point some 110 miles north of San Francisco Bay. Here began the ambitious, methodical and historic hydrographic survey for which Vancouver became so justly famous. For the most part he paid little attention to large river deltas. His chief concern was to find, if possible, a Pacific entrance to the Northwest Passage.

Hopefully he entered that important gap in the coastline that had escaped Capt. Cook's attention three years previously — Juan de Fuca Strait — and its southward extension, now known as Puget Sound. But his aspirations were cooled somewhat when he realized that the waters of this imposing entranceway were, in fact, landlocked.

By the end of May he completed his survey of the Sound, (named after Lieut. Peter Puget, then of the *Discovery*, later to become commander of the *Chatham*). Vancouver gave this region of the mainland the name of New Georgia, a title that failed to endure. But other names Vancouver gave to geographical features have lasted, names such as Mount Rainier, Mount Baker and Mount Hood, all of them immortalizing his contemporaries in the British Navy.

FIGURE 19. Captain Vancouver surveying English Bay near Burrard Inlet, site of the City of Vancouver, B.C.

Between the latitudes of 48 degrees 23 minutes and 52 degrees 19 minutes Vancouver spent three and a half months in the most careful survey work. Late in June, 1792, while operating in Burrard Inlet (named after Sir Harry Burrard of the Navy) and among islands of the Strait of Georgia, he was surprised to find that he was not alone in these measuring activities in this part of the world. In his Narrative Vancouver writes of events of June 22, 1792: "As we were rowing on Friday morning for Point Grey (named after Capt. George Grey of the Navy) purposing there to land and breakfast, we discovered two vessels at anchor . . . a brig and a schooner wearing the colours of Spanish vessels of war . . . They had sailed from Acapulco on the 8th of March in order to prosecute discoveries on this coast . . . I cannot avoid acknowledging that, on this occasion I experienced no small degree of mortification in finding the external shores of the gulph had been visited, and already examined a few miles beyond where my researches during the excursion had extended, making the land I had been in doubt about, an island".[26]

The Spanish ships found near Point Grey, the *Sitel* and the *Mexicana*, were under commanders Galiano and Valdes respectively. Vancouver, acting in accord with his instructions, urged that the Spanish and English expeditions join forces and continue the survey project together. This experiment in collaboration was launched in good faith but soon foundered on the differing national temperaments involved. The initial cordiality soon evaporated and the joint venture was abandoned.

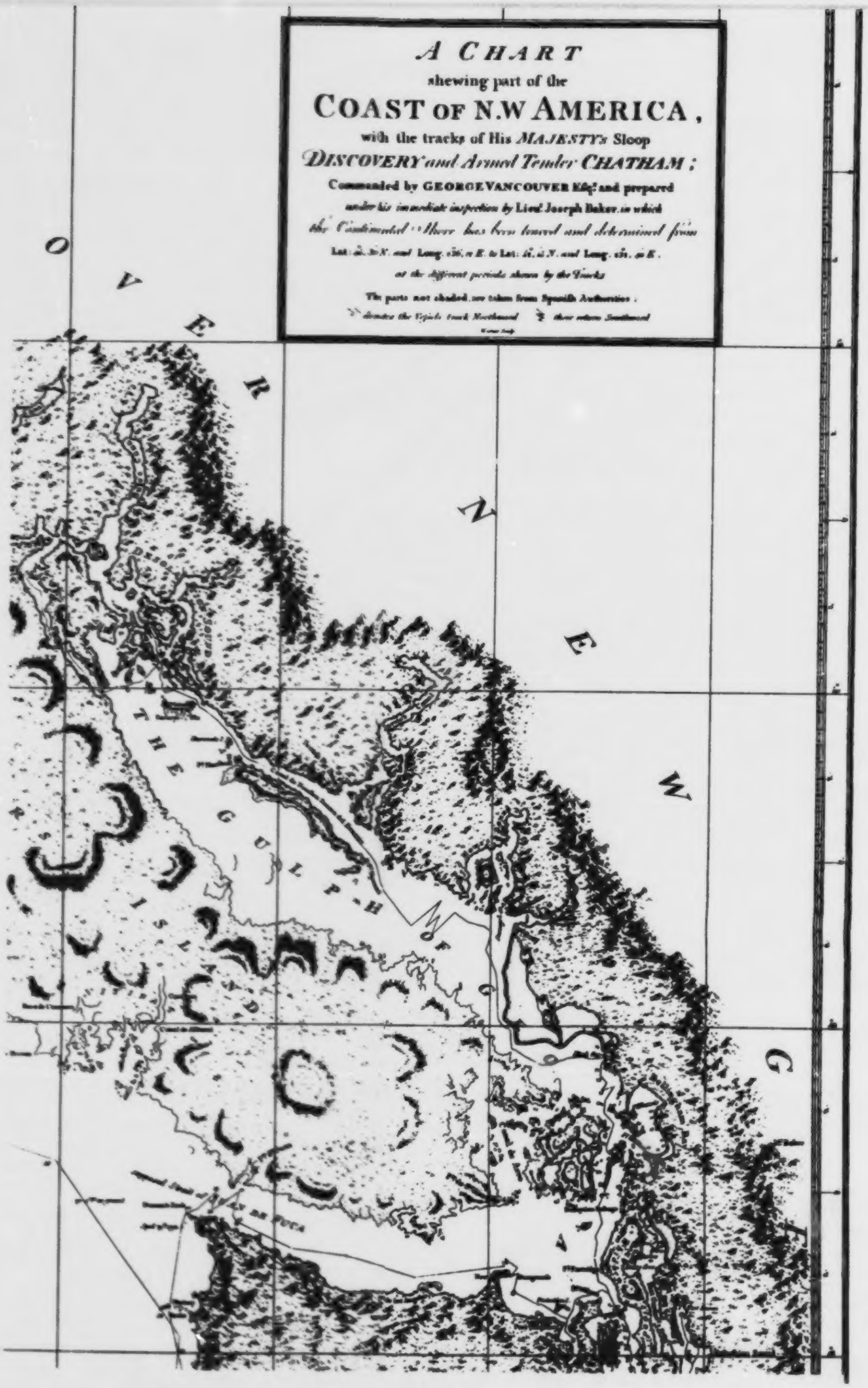
As it was Vancouver's main purpose to uncover a Northwest Passage, if such existed, he reasoned that if he should follow the continental shoreline northwards, examining carefully every possibility, he could hardly miss locating the goal of his endeavors. This seemed wise in the circumstances but the procedure consumed three summer seasons of intensive survey activity.

By the end of May, 1793, Vancouver had reached latitude 52 degrees North. Leaving the *Discovery* anchored in Restoration Bay in Burke Channel, he penetrated by small boat the various arms of the sea to a point on Dean Channel not far from the present-day community of Ocean Falls. That was in early June. In this vicinity his surveying took him very near a rocky point in a cove near Elcho Harbor. This was the farthest westerly point reached by Alexander Mackenzie a few weeks later as he concluded his search for tidewater. It was on the rock face of this point that Mackenzie wrote with vermilion mixed in melted grease his famous, if not durable, inscription.[27] Thus, by a strange historical coincidence, only a few weeks separated visits to the same British Columbia locality by the two leading explorer-surveyors associated with the development of Canada's west coast—one from the sea and one from the land. Vancouver was unaware of Mackenzie's approach overland but on reaching tidewater Mackenzie had hints from the natives that one "Macubah", a white man had recently been seen in his "large canoe". Mackenzie, 10 years in advance of the celebrated Lewis-Clark explorations of the American Northwest, had descended the Bella Coola River, reaching the North Bentinck Arm. This arm of the Pacific, nearly 70 years later, was to become the scene of a survey of importance by Lieut. H. Spencer Palmer of the Royal Engineers, seeking to find a short practical route to the Cariboo district.

Had Vancouver and Mackenzie met, the latter, merely by recounting his own travel experiences, could have solved the Northwest Passage problem faced by Vancouver. As matters turned out Vancouver, on concluding his meticulous search a year later, wrote that his survey "removed every doubt, set aside every opinion of a Northwest Passage . . . within the limits of our researches . . .".[28] Oddly enough, at this Dean Channel stage in the history of exploration in Canada, Charles Vancouver, elder brother of the distinguished marine surveyor, was busy in London pressing for British government support of an overland journey by himself, similar to that accomplished by Alexander Mackenzie.[29]

A combination of intensive survey work, adverse winds and subsequent periods of dead calm, delayed the arrival of the *Discovery* at Nootka Sound until late August, 1792. The *Chatham* reached the Sound in the forenoon of August 28. About 4 o'clock in the afternoon of that same day the appearance of the *Discovery* was greeted by the Spaniards with an echoing 13-gun salute, a gesture to which the British responded in kind. The most cordial courtesies were exchanged but subsequent negotiations for the transfer of Spanish sovereignty proved inconclusive. Broughton was sent to England for new instructions. It was not, however, until March 23, 1795, that British and Spanish commissioners finally met at Nootka Sound and in a brief ceremony British buildings were formally restored and the Union Jack unfurled over the territory.

Vancouver's descriptions of his personal relations with Spaniards on our west



A CHART
shewing part of the
COAST OF N.W AMERICA,
with the tracks of His MAJESTY's Sloop
DISCOVERY and Armed Tender CHATHAM;
Commanded by GEORGE VANCOUVER Esq. and prepared
under his immediate inspection by Lieut. Joseph Baker, in which
the Continental Shore has been traced and determined from
Lat: [illegible] N. and Long. [illegible] E. to Lat: [illegible] N. and Long. [illegible] E.
at the different periods shewn by the Tracks
The parts not shaded, are taken from Spanish Authorities.
denotes the Vessels track Northward; their return Southward
O V E R
N E W G
THE GULPH OF GEORGIA
ISLANDS
DE FUCA

MAP 27. From a survey made in 1792. Courtesy of the Public Archives of Canada.

coast as well as his respectful acknowledgment of their earlier presence as explorers in these waters serve to emphasize the extent of the influence actively exercised by men of Europe's Iberian Peninsula upon Canada's more precise development on world maps. The parts played by early Vikings and by the French in this regard have been well understood. The German and Dutch geographers and map publishers as well as skillful Italian cartographers also made valuable contributions to this process of evolution. But Canadians have not always realized the exceptional importance of the pioneering role performed by Portuguese and Spanish navigators in delineating our Atlantic and Pacific coastlines during the earliest recorded periods of our history. Nevertheless persistent reminders, in the form of picturesque place names, do exist to stir our recollections and our appreciation. Facing the Atlantic and recalling the zeal and craftsmanship of the mariners and mappers of Portugal are to be found such names as Labrador, Portuguese Cove and Cape Race (Rase). On Pacific shores we have names such as Quadra, Juan de Fuca and San Miguel to bear enduring testimony to the initiative, courage and skill displayed by the explorers and chart makers of 18th century Spain.

Vancouver's surveys in the two following seasons, 1793 and 1794 included the Queen Charlotte Islands and the main coastline as far north as Cook's River, later to be named Cook Inlet. Having concluded the entire survey to his own satisfaction Vancouver turned south from Point Conclusion on August 22, 1794, and began his long homeward voyage around the Horn. The *Discovery* and *Chatham* arrived in the Thames on October 20, 1795, although Vancouver regarded the main voyage as completed when the vessels entered the Shannon estuary on September 13. His expedition had consumed 4 years, 8 months and 29 days. The voyage represented one of the most notable, if not the longest marine survey made in the world up to that time. The *Discovery* had logged 65,000 miles, about 10,000 miles more than Cook's most extended single journey. To this mileage ought to be added the 10,000 miles or more covered by the survey party rowboats. During all these danger-ridden years the *Discovery* had lost only 5 men, the *Chatham* none at all!

Vancouver began to organize his journals following his return but his chronic ailment grew worse and, failing rapidly, he died early in May, 1798 at the age of 41. His brother John, assisted by Capt. Puget, completed the editorial work required for the publication of Vancouver's Narrative, which appeared in 1798. The span of Vancouver's 41 years (1757-1798) included the period of the Seven Years' War (1756-1763), a war that cost France the realm of Canada and established British rule in this country and in India. This era also witnessed the beginnings of the industrial revolution in England, of agricultural reforms and social stirrings destined to transform Britain into a parliamentary democracy and a society with a lively interest in every branch of science.

Capt. George Vancouver, conscientious and methodical, with a passion for accuracy, was the natural choice for the exacting task of surveying a rugged coast of exceptional beauty. Despite its undoubted scenic attractions Canada's west coast, with its deep fiords and complex channels, provided a formidable challenge to explorers or marine surveyors. The magnitude and reliability of the surveys and charts completed by Vancouver's expedition has continued, over the years since these occurred, to excite universal admiration. He and his men, in three summer seasons, surveyed and chartered first, the region of Puget Sound and next, the region between latitudes 52 degrees and 56 degrees North, then finally, the region from Cook Inlet southwards to Chatham's Strait. Vancouver accomplished his main purpose, to show that no transcontinental strait existed between those latitudes. In his secondary objective he succeeded also in producing a detailed basic hydrographic survey of the region. His verdict on the significance of his achievement was a shade premature.... "the geography of the earth [is] now placed beyond the influence of conjecture". But the results of his survey were of such precision and so dependable that much of the work he did still remains in use. His was an immense achievement, one that is shared not only with the anonymous but indispensable crewmen but with the competent, loyal and industrious officers of his command, men such as Broughton, Puget, Mudge, Baker, Hanson, Whidbey and Johnstone. Their accomplishments and the permanent fame of the survey expedition are best perpetuated in the name of the pulsing, vital city that is Canada's principal Pacific gateway and in name of the island domain whose principal port is the queen-like capital of British Columbia.

Colonel Joseph F. W. DesBarres

The surveying and charting career of Joseph F. W. DesBarres had concluded by the time of his appointment as Governor of Cape Breton in 1784. At that time he was 63 years of age and such recognition would have been regarded by most men as a comfortable crown to a busy, productive career. But for Col. DesBarres it served only to mark the beginning of a brand new career that would extend over the forty remaining years of his life! His stay in Cape Breton proved a stormy one and within two years of his arrival there he was abruptly recalled by royal command. But somehow he managed to restore himself in the eyes of London authorities, returning to the New World as Governor of Prince Edward Island in 1805, remaining in that post until 1813. Col. DesBarres then took up residence in Halifax where he occupied himself in land settlement and land development projects until his death in 1824.

In the light of his long and distinctive service it would seem that DesBarres' promotions in military rank came uncommonly slowly and in a niggardly spirit. It required 35 years for him to reach a full colonelcy in 1798 from the rank of lieutenant. Making all possible allowances for his quarrelsome and abrasive temperament, DesBarres met with continual opposition, amounting at times to vindictiveness. Not only in the matter of promotions did DesBarres receive tardy justice. When his employer, the Board of Trade and Plantations was disbanded in the midst of his work on *The Atlantic Neptune*, his pay was stopped. The Admiralty allowed him to carry on for several years without remuneration. His personal financial resources exhausted, DesBarres in desperation submitted a bill to the British government for re-imbursement amounting to £21,072 18s. 2d. In time he received upwards of two-thirds of this total but the balance of £8,801 16s 4d, to which he felt he was entitled, was never paid.

It was not until he reached the age of 71 that DesBarres became convinced he had definitely identified his chief opponent in life. Although in his letter of October 15, 1792, addressed to Lord Sydney, his language was uncharacteristically guarded and tactful, the spirit of reproach gleams unmistakably through his careful phrases. Long years of agonizing experiences had at last convinced DesBarres that the man after whom he had named the most important community on Cape Breton Island was, in fact, his life-long personal enemy. If DesBarres was correct in his conclusion then the motive of Lord Sydney's hatred of him remains obscure. DesBarres wrote in sorrow rather than in anger, "None will ever pretend to deny that your Lordship has injured me most fatally in my Reputation, in my Rank, in my Fortune, in the happiness of my mind, and in every point and relation that is dear to man; for though it was your Duty to receive every complaint against me, it was also your Duty to have given me Justice. . . ."[30] Lord Sydney, at that time a retired Cabinet minister, replied on November 3, 1792, in distant, measured and dignified tones, absolving himself from anything but the highest of motives.

Col. DesBarres may have had a deserved reputation for irascibility but he could be intensely sensitive to the requirements of gallantry. In a letter dated December 17, 1806, written from Government House in Charlottetown to the Rt. Hon. W. Windham in London, he advised, "Mrs. Holland, widow of an old Brother Officer, who has rendered many good services to his King and Country, has this moment brought me the enclosed memorial, [author's note: likely an appeal for a government pension], which in compliance to her request I humbly by leave transmit herewith. It is not improbable but that His Royal Highness the Duke of Kent who, I find, interests himself in his situation, will take an opportunity of waiting on you in his behalf".[31]

The Halifax newspaper, *The Acadian Recorder*, paid a glowing editorial tribute to DesBarres on November 6, 1824, following his death in that city:

"Colonel J. F. W. DesBarres was an amiable and valuable warrior . . . His scientific labours on our coasts and his reputation as one of the heroes of 1759 under Wolfe at Quebec . . . gave him a claim on the gratitude and reverence of all Nova Scotians. The Chart which he prepared from his own survey of this province will give his memory claims of gratitude upon the nautical world and could only have been performed by a man of surprising perseverance. . . ."

The teacher of marine surveying, sketching and navigation to such as Capt. James Cook and Admiralty Hydrographer Capt. Thomas Hurd; compiler of *The Atlantic Neptune*, soldier, hydrographer, artist, man of action, of affairs and a governor of His Majesty's territories, Joseph Frederick Wallet DesBarres was a man of outstanding achievements and distinguished service.

The Great Lakes Surveys

The peace that followed the Napoleonic Wars in Europe and the War of 1812 in America made possible a renewal of British government interest and activity in survey voyages into Canada's Arctic, along its major rivers and in its Great Lakes. Commercial advantages motivated Arctic explorations but in Canada's border waters in the south, large and small, diplomacy and defence inspired the original scientific probings of the surveyor and chart maker.

Although systematic marine surveys of the Great Lakes and their connecting waters were not initiated until 1815, there is good reason to believe that limited, isolated surveys of a hydrographic nature, did occur almost a half-century earlier. In the year of the Treaty of Paris and the creation of the province of Quebec, and when Governor Murray received from the British Crown the first set of instructions for surveying land in the new province, there were official measuring missions carried out between Lake Erie and Lake Huron. In the *Journal of Pontiac's Conspiracy* and John Rutherford's *Narrative of a Captivity*, there is this entry for May 7, 1763:

"Mr. Robertson, a ship captain [and a] colonel of militia . . . acting under orders of the Commandant [of Detroit] had gone with 10 soldiers and a Pawnee servant *to sound the channels* to see if there was enough water for a vessel to pass in case of need".[32] (author's italics) Exploring and charting these waters was a natural consequence of the introduction of sailing vessels on the Upper Lakes. As early as the summer of 1761 Sir William Johnson found the schooner *Huron* already launched and Lieut. Charles Robertson[33] engaged in sounding the Niagara River near the eastern outlet of Lake Erie. On May 2, 1763, Robertson took a party of 11 in a large bateau to explore and sound the St. Clair River, curious to find if communication with Mackinac was possible. In addition to soldiers and sailors the group included Sir Robert Davers, his Indian slave boy and young John Rutherford. Near the entrance to Lake Huron the party was ambushed by Indians and all were killed or taken prisoner. One of the two made captive was John Rutherford, author of the recorded account of the incident and aftermath.

Before the close of the 18th century there was another development of hydrographic importance on the "sweet water" lakes. In 1788 Lord Dorchester sent Capt. Gother Mann on a tour of the region in order to gather information valuable in case of open hostilities with the United States. Capt. Mann had come to Quebec about 1785 and by the time his active service career had ended he was commander of the Corps of Royal Engineers. Mann's 1788 survey extended to Sault Ste. Marie but Lake Huron absorbed much of his time. His observations on Lake Huron substantially increased information then available concerning the nature of its shores and waters. The entire coastline of Georgian Bay was examined by him and many inlets and river mouths charted for the first time.[34]

"A great solitude, little known or frequented except by some Indians" was Mann's description of the Georgian Bay region of that time. More than a quarter-century was to pass before systematic surveys were initiated on the Canadian Great Lakes. In 1815, when peace had been restored in America, Sir Edward W. C. R. Owen was appointed commodore and commander-in-chief of British naval forces on the lakes. He, in turn, appointed his younger brother, Capt. William Fitzwilliam Owen, to the post of chief hydrographer in the area. Both in their early forties and both experienced naval officers, these men accomplished an astonishing volume of surveying, considering the times in which they operated. Naval actions on the lakes in the War of 1812-14, as well as the safety of navigation generally, had served to emphasize the need for accurate surveys of these border waters. Upwards of 40 British war vessels were on the lakes at war's end and for these ships alone increased charting was essential for their safe navigation.

Significant marine survey developments followed the end of hostilities in the 1812-14 War in America. The British Admiralty, as we have observed already, turned its attention to a fairly intensive examination of Canada's northern seas. The *Rosamond*, a British war vessel, suddenly released at Spithead from the prospect of active service in American waters, received orders to proceed to Hudson Bay. In his published narrative of that history-making voyage, Lieut. Edward Chappell, one of the ship's officers, describes hydrographic surveys conducted by that vessel in the Bay in August, 1814. The entire voyage from Spithead and return extended from mid-May to November 17 of that year. A frontispiece map in Chappell's book is titled: "Map of the Great Nelson River from Great Lake Winnipeg to Gull Lake" and is drawn by William Hillier, Master. It shows portages, falls and rapids in the Nelson River, according to information supplied to the draftsman.

Lieut. Chappell complains occasionally of the Admiralty charts of the Bay entrances: ". . . nothing can be more incorrect than the Chart supplied by the Admiralty for the guidance of a man-of-war in Hudson's Straits; it absolutely bears no resemblance to the channel . . ." The inadequacies in mapping was due, in Lieut. Chappell's view, to the reluctance of officers of the Hudson's Bay Company to divulge to any outsiders, navigational information in their possession relating to the Bay or its entranceways.

The book also contains tables of soundings taken by the *Rosamond* south of York Factory as well as statements on compass variations observed en route to Hudson Bay. There is, in addition, a table of thermometrical observations taken with a spirit thermometer (Fahrenheit).[35] The *Rosamond* was so seriously damaged as a result of sea ice on this voyage that, upon its return, it was decommissioned and sold out of His Majesty's service.

In the season of 1815 several survey parties were sent out on the lakes and at the end of the year Sir Edward was able to supply the British Admiralty with more than 50 charts related to navigable waters all the way from Galop's Island to St. Mary's River. Thus a good foundation was laid for work that continued for years to come. In 1815 Capt. William F. Owen was occupied on various surveys from the St. Lawrence to Georgian Bay. His chief assistants were Lieut. Alexander Thomas Emeric Vidal and Mr. John Harris, Master, R.N. The schooner gunboat *Huron* was used during the closing weeks of this survey season and special attention given to the eastern shores of Lake Huron and Georgian Bay.

Lieut. (later Capt.) Vidal came to Halifax naval station on the *Niobe*. He was employed there and on the Great Lakes from February to November, 1815, principally in the surveying service. His brother, Emeric Essex Vidal, R.N., was a gifted sketcher and his 1815 water color representations of Kingston Harbor and Sackett's Harbor are still in existence.* H.M.S. *Vidal,* (named after Capt. A. T. E. Vidal) was the British survey vessel employed in the famous "Rockall" expedition of 1955 in the waters north of the British Isles.[36] After receiving his commission on August 25, 1818, Lieut. A. T. E. Vidal went with Capt. William F. Owen on surveys for the Admiralty in African waters and other places until 1846.

It had been the intention of the Admiralty to establish headquarters for the Great Lakes service at Quebec, nearer salt water, but as most of Sir Edward Owen's time was spent at or near Kingston, this place became the base of his surveying operations. Capt. William F. Owen, after whom Owen Sound came to be named, served as commander of the Kingston dockyard. Following his relatively brief period as Chief Admiralty Hydrographer on the lakes and in 1817 (after he had departed from Canada) there was produced under his direction a very good chart of Kingston harbor and its approaches.[37] In the 1840s he returned to Canada to conduct surveys in the Bay of Fundy.**

During his first season of surveying on the lakes Capt. Owen resolved to go to Quebec to enlist the services of an assistant, if he could find anyone suitable. At Quebec he met a 20-year old midshipman aboard the *Wanderer* and made a momentous decision. The studious habits of young Henry Wolsey Bayfield (1795-1885) impressed Owen as did the exceptional neatness of the lad's notebooks. Bayfield, for his part, was less than enthusiastic over the prospect of leaving his ship and his promising naval career for the vagaries, hardships and low pay of hydrographic survey work. But somehow Capt. Owen prevailed upon him to make the transfer, possibly on the strength of promises of rapid promotion. Bayfield, who had been in the navy from the age of 11, could hardly have foreseen at this stage his eventual rise to the rank of full Admiral, in recognition of over 40 years of sterling marine survey work. As it was, he became Lieut. Bayfield soon after accepting Owen's offer and at a time when the double-front system of land surveys was being introduced in Upper Canada. Bayfield had been in

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*Library, Royal Military College, Kingston.

**There is evidence to indicate that Captain Owen visited Canada in the late 1830s.

America about a year before he was approached by Owen. He was officially posted to the lakes survey in September, 1816.

In addition to John Harris, R.N. (1782-1850) and Lieut. Vidal, others active in these early Admiralty surveys of the Great Lakes were Lieut. A. B. Becher, R.N. and Lieut. George Cranfield, R.E. All these men, along with Lieut. Bayfield, wintered in 1816-17 at Kingston. They were accommodated in the Harris home and worked in the Hydrographic Office in a building overlooking the harbor. In a letter to Mrs. John Harris dated May 5, 1829, Bayfield described this Kingston sojourn "with all its labors, the happiest of my life".

Bayfield remained with Capt. Owen, as his assistant, until Owen left Canada in 1817. On June 17, 1817, Bayfield was appointed an Admiralty surveyor. For the next nine years he extended his marine surveys over the whole of the Canadian Great Lakes. For two years he was on Lake Erie, four years on Lake Huron and Georgian Bay, and three on Lake Superior and the North Channel. During surveys on the latter lake he used the schooner *Recovery*. Wintry weather failed to hinder him. Often he would chop holes in thick ice in order to determine depths.

Capt. J. G. Boulton, who succeeded Bayfield in this lake survey work, was an enthusiastic admirer of his predecessor: "The Admiralty Survey Service has produced good men from Captain Cook onwards but I doubt whether the British Navy has ever possessed a more gifted and zealous surveyor than Bayfield. He had a marvellous combination of natural talent and tremendous physical energy . . ."[38] And again, "While making a survey of the Georgian Bay and North Channel of Lake Huron from 1883 to 1893, under orders of the Dominion government, I had a good opportunity of witnessing the marvellous quantity and excellence of Bayfield's work. He had neither the time nor the means to find all the outlying rocks and shoals nor was it necessary, 90 years ago, in that locality where his open boats were probably the largest craft sailing thereon".

In 1825 Bayfield left the Great Lakes area, never to return there for surveying operations. He went to England where he worked at the Admiralty completing charts based on his explorations of the previous decade and in preparing them for the engraver. In 1827 he was back in Canada surveying in the St. Lawrence River and Gulf. His appointment to this task was formally confirmed in the autumn of 1827 and the area of his operations was extended to include Anticosti, the Magdalen Islands, Prince Edward Island, Sable Island, Cape Breton and the coast of Nova Scotia as far as Halifax. All this took place at a time when Col. John By of the Royal Engineers was superintending the commencement of work of the Rideau Canal at Ottawa. Capt. John Franklin (August 16, 1827) ceremoniously laid the first stone in the construction of the canal at its Bytown terminus, as he paused briefly on returning to England from the first of three historic Arctic journeys.

Bayfield made Quebec his winter headquarters until 1841 when he transferred to Charlottetown, as the survey work had by then reached the eastern areas of the Gulf. During these years of hard toil and hazards Bayfield had the valuable assistance of such able naval officers as Lieut. John Orlebar (made Commander, 1845) who eventually succeeded Bayfield; Lieut. George A. Bedford (later made a Vice-Admiral); Lieut. P. E. Collins, drowned off the Magdalens in 1835; Midshipman A. F. J. Bowen, R.N., who returned to England, and Dr. William Kelly, M.D. It was the sudden death of Collins that brought Orlebar to Bayfield's aid in the emergency.

Bayfield would measure small bases a quarter-mile long, every 20 or 30 miles, using a chain or well-stretched lead-line. The coast between would be triangulated by the land features, if possible. Ultimate scales of charts would be determined from distances calculated between stations. Bayfield himself took nearly all the observations required for fixing latitude, using a sextant. For longitude, he made Quebec Citadel his secondary meridian, determining its longitude west of Greenwich by moon occullations and eclipses of Jupiter's satellites.

Meridians of longitude east and west of Quebec were determined by chronometers. Every opportunity was taken by Bayfield and his assistants to observe by theodolite the astronomical bearings of stations on prominent headlands. . . . Sextant observations for defining longitude were usually taken by day, those for latitude at night, both actions being dependent upon clear skies. A large part of Bayfield's time was occupied in these calculations, or in soundings with the aid of a Massey sounding machine, with the plotting of stations on various large-scale plans of harbors and smaller scale coast sheets, also in supervising the 'detached' parties on shoreline detail.

Winters were occupied in completing the plotting of remaining details on rough sheets and plans and the construction of more comprehensive small-scale charts on Mercator's projection. The astronomically determined stations were laid down by Bayfield himself. Between these stations the coast details and soundings were squared in from the roughs. Fair copies were laid down of the whole and in the spring transmitted to the Admiralty Hydrographer for publication. Sailing directions were also drawn up to accompany the charts.

In mid-September, 1832, while in Gaspé, Bayfield reported that he had "measured a base of about 1¼ miles and observed at night the immersion of Jupiter's first and third satellites for longitude". Bayfield had something to say also about one of the perpetual afflictions suffered by surveyors in Canada. In late August of that same season, while in Labrador, he comments: "I never saw the moschettoes and black flies thicker; their bites covered us with blood while observing, and we could not open our mouths without swallowing them. The torment of them was beyond description—men, painting and working at the rigging, smeared themselves with paint, oil and tar in vain . . .".[39]

In the May 19, 1828 issue of the *Quebec Gazette* the following news item appeared: "The hired schooner *Gulnare*, 140 tons, built for Capt. Bayfield, R.N., as a surveying vessel, was launched yesterday from Mr. Taylor's shipyard. She is a fine vessel, owned by Mr. Stevenson, merchant . . .". This was the first of three survey vessels named *Gulnare* to be used during Bayfield's period of service. The first *Gulnare* was condemned as unseaworthy in December, 1843, after 15 years of hard service. The second *Gulnare* was launched at Charlottetown on May 18, 1844. The third *Gulnare* (212 tons) built at Quebec, arrived at Charlottetown for the commencement of the survey season in April, 1852.

In 1833 the first *Gulnare* had the honor of being towed in the St. Lawrence by *The Royal William* which made the historic Atlantic crossing that summer. Bayfield worked along the north shore to the Strait of Belle Isle that season—"Cook's plan of Chateau Bay, Labrador, is excellent" he comments. During the summer Bayfield experienced difficulties because of drunkenness and insubordination among the crew. In 1836 the Admiralty advised that, as an economy measure, Bayfield and his officers in the surveying service had been placed on half-pay in common with those on shore . . ."

In October, 1842, Capt. Bayfield found another Admiralty survey ship, the *Columbia*, active in his general field of operations. Her commander was an old friend, Capt. W. F. Owen. At Charlottetown the officers of the *Gulnare* and *Columbia* joined in consultations for the purpose of linking Owen's proposed survey of the Bay of

Fundy with stations already established by Capt. Bayfield. The two commanders and their crews also cooperated in 1843 in a series of experiments, using rockets to denote times and positions, in the fixing of meridians of longitude. On July 29, when the *Gulnare* was in Halifax harbor, rockets exploded that night by the *Columbia* in Bedford Basin were observed at a distance of 25 miles. Assisting Owen at this time was Peter Frederick Shortland who succeeded as commander of the *Columbia* and who became eventually a Vice-Admiral in the Royal Navy.

Capt. Bayfield had competent assistants in his survey work but he continued to feel the need of clerical help. "The want of a clerk or other person", he wrote on December 8, 1843, "to assist me in writing is severely felt, which may be imagined when I state that I wrote 14 pages of foolscap today".[40] In those days he was in the habit of signing most of his letters "Henry W. Bayfield, R.N., Surveying the Gulf of St. Lawrence".

At Pictou in August, 1846, Bayfield found orders awaiting his arrival there "to proceed to Canada and put himself at the disposal of the Governor General for an examination of the channels of Lake St. Peter, with a view to the excavation of a channel". Bayfield's fiscal worries were not confined to low rates of pay. On February 23, 1847, he received a letter from the Admiralty Hydrographer, Admiral Beaufort, "limiting the annual expenditure of this service to £2,400 sterling, exclusive of pay and allowances of yourself and officers".

On June 12, 1849, Bayfield made a significant comment on the accuracy of earlier charts of the Gulf region: "I have not in the least exaggerated", he stated in a letter to the Admiralty Hydrographer, "the defects of the old charts of the Gulf, Cape Breton and Nova Scotia. There are none of them that can with any degree of safety be trusted by the seaman, excepting those of Cook and Lane. At least none have come under my observation that are not a reproach to this age of improved hydrography. When I consider the still greater importance that exists respecting the coasts of many other countries, I cannot but think that the select committee might at least have touched more lightly a Department so evidently useful to the world . . .".[41]

By 1850 Bayfield's health was beginning to fail. With great reluctance he placed Capt. Alexander McLeod in charge of the *Gulnare* that season. He wrote, "It is not without pain that I shall see the *Gulnare* sail without me. But when I remember that it is the first time for 24 years, all feeling of discontent is removed. Crew trouble again . . .". When he passed the sixty-year mark Capt. Bayfield's health had become much more precarious. In promoting him to the rank of Rear-Admiral on October 21, 1856, possibly the Admiralty had evidently discovered a way to persuade the old sea dog to curb his ambitions. In any event this promotion automatically required him to give up active survey work. Seven years later he was elevated to the status of Vice-Admiral and on October 18, 1867, the year of Confederation, Henry Wolsey Bayfield was appointed full Admiral with a Greenwich Hospital pension of £150 per annum in addition to his normal pension. He was succeeded in the surveys by Commander John Orlebar.

Of Bayfield, Capt. Boulton recalls: "His distinguished appearance and kindly countenance won him respectful recognition wherever he went. But for several years he has been an invalid and unable to leave his room . . . The admiral was a man of high religious principle, kind to the poor and disposed to aid every good work. His noble Christian example did much to exert beneficial influence on the higher circles of our city life. Few have rendered more practical benefit to the commerce of the nation and to the navy itself by his careful coast surveys and excellent charts . . .".[42]

The Lieutenant Governor of Prince Edward Island, Sir Henry V. Huntly, paid tribute to the eminent hydrographer in his address at the opening of the provincial legislature on March 4, 1845:

"Now that the dangers upon the coasts of this Island and the numerous obstructions at the entrance of the different harbours have been so elaborately laid down by Captain Bayfield and officers of the Royal Navy serving under him, I trust that you will make provision for the erection and financial support of the lighthouse already proposed to be placed at Point Prim".

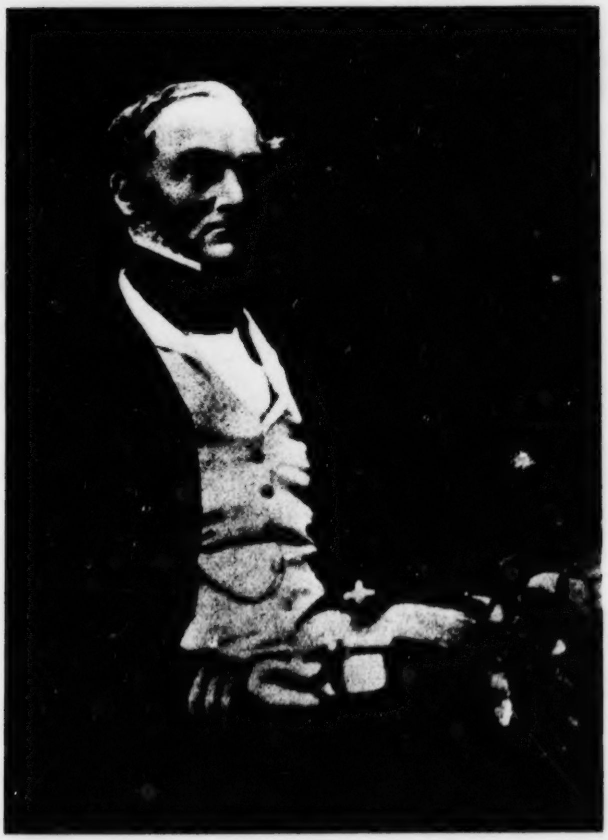

FIGURE 20
Admiral H. W. Bayfield, R.N., F.A.S.

More than 56 Bayfield charts were produced during his active career, at least 16 of them relating to the Great Lakes. His manuscript map of Lake Superior is particularly impressive in its scope and detail. Bayfield River, near Goderich, Wolsey Lake and Bayfield Sound, all in western Ontario, help to commemorate the admiral's work and perpetuate his name. Today, on a plaque placed in the central square of Charlottetown, where the idea of Confederation received its first great impetus, there is this inscription:

"Commemorating the distinguished services to navigation and science of Admiral Henry Wolsey Bayfield (1795-1885) whose work superseded the pioneer surveys of Admiral Durell, Captain Holland and Lieut. Desbarres. Between 1827 and 1856 after his work on the Great Lakes he conducted a thorough survey of the Gulf and River St. Lawrence, the coasts of Anticosti, Magdalen Islands, Prince Edward Island, Cape Breton, Sable Island and parts of Nova Scotia and Labrador".

14

THE EARLY PENETRATION OF CANADA'S WESTERN INTERIOR

As the 17th century dawned in North America the vast bulk of the continent remained unrevealed to the white man. Was its hinterland a relatively narrow belt lying just beyond the known horizon, or did the land mass extend for thousands of miles? Was that land divided by a strait leading from the eastern seaboard to the Pacific and thus to the Orient? These and other related questions continued to perplex the geographers of Europe.

Champlain and subsequent missionary explorers found that the Great Lakes were, in fact, large closed bodies of 'sweet water' and not inland seas. But it was not until the Hudson's Bay Company was formed in 1670 and when their men, as well as rival French fur traders, began to penetrate to the broad western plains, that the Canadian West began to emerge from obscurity and to take shape as a distinct geographical entity. The unfolding of the western interior, the demonstration of the absence of any transcontinental water passage, the existence of the Rocky Mountains barrier as well as the reaching of tidewater from the East, all resulted from a restless, driving search for the Western Ocean.

Two centuries of ceaseless quest and of gruelling physical hardship were to pass before white men were able to establish the general location, by parallels of latitude and meridians of longitude, of parts of the three ocean coasts of Canada. The pioneers who achieved this were the forerunners of a more or less steady tide of Europeans, sweeping into the west in remorseless waves. With them came the white man's way of living and attitudes towards life and its meaning. By the time of the United Empire Loyalist influx, the Red Indian way of life was doomed. It was but a matter of time before fur traders and explorer-mappers, pushing boldly westward, would give way to rugged frontiersmen and they, in turn, would yield place to the scientific explorer-surveyors.

Behind them came the advance guard of settlement accompanied by the first land surveyors and trained mappers.

The lively 17th century struggle between French and English for sovereignty and trading rights in the Hudson Bay regions, finally won by the English, was succeeded by an intensive rivalry between the English-inspired and English-led Hudson's Bay Company and the Canadian-inspired and Canadian-led North West Company. The earliest exploratory journey and mapping activity in the Canadian West, as far as the Rockies, were the consequence of the commercial competition engendered by the giant fur-trading companies.

Contrary to an impression all too general outside Canada even today, the territory within the borders of what are now Manitoba, Saskatchewan and Alberta is not entirely prairie land. Because it consists, rather, of plains, lake country, parkland and foothills, the term 'western interior' favored by John Warkentin, is being employed in this work in the interests of more precise description.[1] The first recorded visit of a white man to the western interior of Canada was made by Henry Kelsey. In 1684 he arrived at York Factory as a Hudson's Bay Company employee. On June 12, 1690, he left York Factory and travelled to what is now south central Alberta, returning to the Bay in the summer of 1692. Kelsey's aim was not to survey or to map, but to try to persuade the Plains Indians to trade with the English at Hudson Bay, rather than with the French.[2] Kelsey was the first of a distinguished company of western discoverers whose explorations were closely associated with the expansion of fur-trading activities in that region.

It was all very well for Kelsey to concentrate upon exploration, and to be content with his oral or written descriptions, but it soon became apparent to the fur companies that in order to carry on trade properly and profitably, it would be necessary for them to obtain reliable maps indicating clearly the routes and mileages as well as the location of trading posts and the exact distances between them.

The major regions of the interior of Canada, north of the 49th parallel, were explored through two main entranceways; Hudson Bay and its main tributaries on the one hand, and the St. Lawrence River and Great Lakes on the other. In 1715 the Hudson's Bay Company sent William Stewart from York Factory westwards with a party of Indians. The aim of this venture was to establish good relations with natives in the territory between Hudson Bay and Great Slave Lake. After a year's absence Stewart returned and described his journey to the Governor of York Factory who inscribed in the post journal that Stewart had travelled "N. NWt about 400 miles, then they went N. Wt to Cross the Baren Desarts and when they had cross'd them, they went W N Wt and came into a very Plentiful Country for Beasts".[3] By this feat Stewart became the first European to cross the Barrens.

In 1733 Joseph Robson, a stonemason and surveyor, arrived at Churchill to help in the construction of the fort there. The Hudson's Bay Company brought him back again to the Bay in 1744 and supplied him with surveying instruments. He mapped only parts of the coastline, never venturing inland. His maps and plans of H.B.C. forts are both detailed and accurate. Robson returned to England in 1748, a bitter critic of the company. A book that he published in 1752, describing the regions in which he had made surveys, contained severe attacks on his former employers.[4]

By 1774 the Hudson's Bay Company had taken initial steps to promote the preparation of maps of territories in which it was active. In keeping with the usual trend of North American developments, British interest in cartography lagged behind that of the French. Ten years previously the La Vérendryes had relayed maps of the western interior of Canada to their principals in the east. But it should be pointed out that the

American Revolution considerably impeded and delayed plans of the H.B.C. to investigate and map the interior of British North America.

During the period of Robson's visits to the Bay, the son of the Governor of the district in Quebec of which Three Rivers was the capital, was exploring, with his sons and nephew, the western interior by way of the Great Lakes entranceway. Pierre Gaultier de Varennes, Sieur de la Vérendrye (1685-1749) impressed the name of his family imperishably upon the pages of early western Canadian history.

In the early summer of 1731, after resigning his charge of a trading post on Lake Nipigon, the senior La Vérendrye took with him a curious map drawn by the Indian, Ochagach.[5] In 1729, while in his forties, père La Vérendrye, then a fur trader in the Lake Superior area, asked authorities in New France to sanction a search by him for the Western Sea. Two years later, by his appointment as Commandant of Western Posts, he was authorized to organize expeditions of exploration, provided he financed his own supplies and crew's wages! His eldest son, Jean Baptiste (1713-36) and his nephew, La Jemeraye, were killed on Massacre Island, Lake of the Woods in 1736 by Indians but not before the former had founded Fort Maurepas on the Red River. The white man stood poised on the threshold of the West.

In 1736 the senior La Vérendrye reached the junction of the Assiniboine and Red Rivers and built Fort Rouge there. In the years following the building of Fort Maurepas and Fort Rouge, La Vérendrye and his three remaining sons built a chain of forts and trading posts along the Assiniboine and Saskatchewan River valleys. Pierre Gaultier, the second son, (1714-55), writing in 1737 to the Marquis de Beauharnois, stated:

"I got the most experienced chiefs of the two tribes (Cree and Assiniboine) to make a map of the country, which I have the honour, Monsieur, to send you . . . You will see by this map, Monsieur, the heights of land . . ."[6]

On this very early map of the western interior the relative locations of natural features, such as lakes and rivers, were established by young La Vérendrye. He also drew attention to a basic factor in western Canadian geography, the distribution between woodland and true prairie.

In September, 1738, the senior La Vérendrye set out from Fort Rouge, following the Assiniboine River across what is now Southern Manitoba to Poplar Point, just south of Lake Manitoba. From there he struck southwards toward the Missouri River country. Some of his descriptions foreshadow the style of expression characterizing surveyors' reports of the future in Canada:

"On the 21st (October) we continued our journey as far as the first mountain (Pembina Mountain) distant from our fort 26 leagues, the general direction being south one point west, from the first mountain to the second (Turtle Mountain) is west one point south, 24 leagues; and from the point of the second mountain to go in a straight line to the Mandan you have to keep s.w. one point west."[7]

As La Vérendrye was then in his mid-fifties he found some of the exertions involved in these travels strenuous tests of his physical stamina:

"From the first mountain the whole route lay in prairie country, but with a succession of hills and valleys, which it is fatiguing to climb up and down several times a day. There are some magnificent plains of 3 or 4 leagues in extent."

His health, in fact, was waning and he was compelled to return to Quebec where he died a few years later, in 1749. But his principal work was done, namely, the establishing of French competition for the Hudson's Bay Company in the western interior and the selection of the Saskatchewan River as the most promising route to the Western Ocean.

La Vérendrye's contribution to western cartography is small but noteworthy. His most significant map, dated 1740, is now in the Marine Department Library in Paris. His manuscript maps, rough sketches only, were sent to Quebec government officials and, in turn, forwarded to Paris where these provided data useful in the compilation there of maps of North America.

The third son, François, Chevalier de la Vérendrye (1715-94) and the youngest, Louis Joseph (1717-61) followed the trail-blazing example of their illustrious father. It was François who is credited with the discovery of the Saskatchewan River in 1749 which he ascended with his brother to the junction of the north and south branches that year. No western flowing rivers were found by the La Vérendrye family or others exploring the interior, and the main hope for finding any such streams at that time rested on the route of the Saskatchewan.

Stimulated by the French penetration of the West, the Hudson's Bay Company in 1754 ordered Anthony Henday to travel inland with a party of Indians to try to induce natives to bring their furs to the Bay. If Henday (or Hendry) was not the first European to sight the Canadian Rockies, he was among the very first to do so. He had joined the Hudson's Bay Company in 1750 and, as Henry Kelsey had done 64 years earlier, he travelled alone into strange, Indian-occupied territory. In the autumn of 1754 Henday caught his first glimpse of the Rocky Mountains. He arrived back at York Fort on June 20, 1755.[8]

By the last half of the 18th century the Hudson's Bay Company's policy of exploration had become truly aggressive. In that period the Company produced such discoverer-surveyors and mappers as Samuel Hearne, Peter Fidler, Philip Turnor and David Thompson. Samuel Hearne (1745-92) entered the employ of the company at 21 years of age. Three years later he was chosen to travel with a group of Indians northwest along the Churchill River in search of copper ore, rumors of deposits of which had been circulating for some time in the Bay area. Two Indians, for example, appeared in 1768 at Fort Churchill carrying samples of free copper and "a rude sketch, drawn with charcoal on a deer's skin, of a map of the country to the northward of Churchill".[9]

It was on the strength of these copper samples and the deer-skin map that Hearne's employers decided to send him on a journey to chart the route to the copper mine. "In consequence . . . the Committee resolved to send an intelligent person by land to observe the latitudes and longitudes of the river's mouth, to make a chart of the country he might walk through . . . By the ship that went to Churchill in the summer of 1769, the Company sent out some astronomical instruments, very portable and fit for such observations as they required me to make."

Hearne made three separate probes before he achieved success. His 1769 attempt failed to reach beyond what is now northern Manitoba. In the following year he did cross into the Barrens. On the third journey, lasting from December 7, 1770 to June 30, 1772, and guided by the very competent Matonabbie, he reached the Arctic mouth of the Coppermine River.

Hearne was not a superior type of surveyor or mapper. The inaccurate map accompanying his Journal shows the routes he followed as well as the rivers and lakes he discovered. However, the fact that he produced a map at all is a solid achievement. The country he explored was not visited again by white men until at least 50 years later when Franklin reached the Coppermine by way of Great Slave Lake.

"The track [sic] of land", states Hearne in his description of the Barrens in his

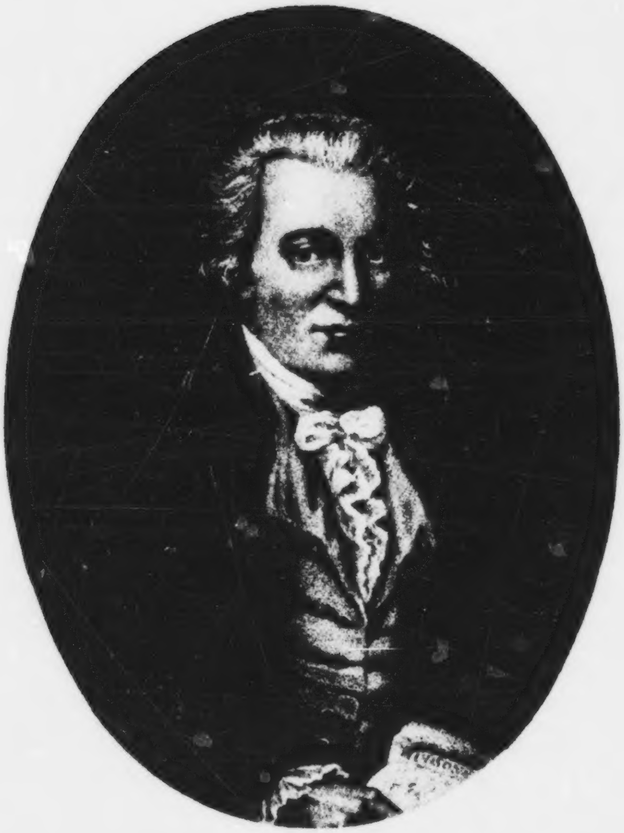

FIGURE 21
Samuel Hearne.

Journal, "inhabited by the Northern Indians is very extensive, reaching from the 59th to 68th degree of North latitude; and from east to west is upward of 500 miles wide".[10] Summing up, Hearne declares dogmatically, "Though my discoveries are not likely to prove of any . . . advantage to the nation at large, or indeed to the Hudson's Bay Company, it had put a final end to all disputes concerning a northwest passage through Hudson Bay".

It is interesting to consider the types of survey instruments on which Hearne relied. On his second venture into the North his Hadley's quadrant, which had proved 'very portable' had been damaged in an accident in August, 1770. But this was not an unmitigated disaster. The loss, though serious, had the result of demonstrating the unreliability of his Indian guide. Hearne's party reached 60 degrees North latitude when "they were entirely lost". Without the quadrant it was impossible to observe for latitude and thus the party was forced to return to its Fort Churchill base. In the preface to his Journal Hearne comments, "My broken Quadrant was a Hadley's with a bubble attached to it for a horizon and made by Daniel Scatlie of Wapping".

On his third journey Hearne was equipped with an old, cumbersome Elton's quadrant. It proved to be a heavy burden on the trail. One version of the official instructions issued to Hearne included the admonition, "If Your Observing Instrument should happen to Break or be useless as was the Case before, Don't let that hinder you from proceeding in order to see if Ye River will be worthy of any further Notice or Not".[11]

This order was unreasonable from the discovery aspect, as there would be little purpose in claiming sovereignty of any land undescribed in terms of latitude or longtitude. In any event Hearne could only estimate his longitude on the basis of the length and direction of his daily journeys. For that matter his latitudes were none too accurately calculated either. On his third journey he was in error by 2 degrees of latitude on the most important of his observations. On July 1, 1771, Hearne placed the Arctic Coast of Canada, at the mouth of the Coppermine River, some 200 miles north of its true location.

His mapping techniques also left something to be desired although his cartographic efforts ought to be assessed in the light of 18th century standards and not by those of the 20th century. But for more than a century, until J. B. Tyrrell's journeys in the Barrens, Hearne's book and map constituted the only available source of information on this important area of Canada's northland.[12]

One of the most outstanding, if also the most unstable, of the 18th century explorer-mappers of Canada's western interior was Peter Pond (1740-1807). Born at Milford, Connecticut, he came to the Canadian West in 1775 to trade in furs. Aggressive, a born explorer, unquestionably courageous and possessing marked all-round ability. Pond's career in the wilderness was a brief, yet stormy one. Pond's violent temper soon created trouble of the first magnitude. When a trader named Wadin was killed in an encounter with Pond and his employees in 1782, Pond and one of his clerks were brought to Montreal to stand trial for murder. However, the authorities decided that a Quebec court was without legal jurisdiction in any of these remote territories and the two men were released from custody in that same year.[13]

About this time a new fur trading corporation, the XY Company, came into active competition with the North West Company, to which Pond belonged. John Ross, a prominent fur trader in the Northwest, was the XY representative at Athabasca and a keen rival of Pond. In a scuffle one night during the winter of 1786-87, involving Pond and his associates at Lac La Ronge, Ross was knifed in the thigh and bled to death. Partly because the North West Company did not want the XY people to press court charges as a result of this deplorable incident, a merger of the two companies took place, in 1787, in the form of an enlarged North West Company.

In the fields of exploration and cartography Pond had a creative vision of the long-range significance of his discoveries. He foresaw with clarity the system of continental communications that would develop from his findings. He possessed other splendid pioneering qualities as well. After Pond joined the North West Company in 1785 he was sent out to organize the company's activities in the Athabasca department. At Athabasca he soon developed a vegetable garden to supplement his transported food supply and thus brought into existence the most northerly agricultural project in the New World at that time.[14]

Between 1784 and 1790 inclusive Pond drew a number of maps of Western Canada portraying his travel routes. His cartography was the first fairly complete representation of the western interior, especially in showing the pattern of rivers. In later maps he made the mistake, however, of showing the Mackenzie River flowing into the North Pacific, rather than into the Arctic Ocean. Pond was the first white man to report the existence of what later became known as the Methy Portage, located northwest of Peter Pond Lake (near the present Alberta-Saskatchewan border) by which route the Clearwater River was reached. Alexander Mackenzie wrote of this feature: ". . . is the ridge that divides the waters which discharge themselves into Hudson Bay, from those that flow into the Northern Ocean, and is in latitude 56.20 and longitude 109.15 West". The waters of the Clearwater flowed into the Peace River which, in turn, entered Lake Athabasca. Pond realized the strategic value of this portage and his own plans and geographical concepts made possible Alexander Mackenzie's celebrated journey to the Pacific Ocean about a decade later.

But Peter Pond, in addition to the misplacement of the Mackenzie River's mouth, drew other erroneous conclusions concerning that great watercourse. "From out of the Great Slave Lake", he recounted, "runs a very large River, which runs almost South West, and has the largest Falls on it in the known world, it is at least 2 miles wide where the Falls are, and an amazing Body of Water. This River leaves the Lake on Latitude 64 and Longitude 135 and the Falls are in Longitude 141".[15] This would place Great Slave Lake in present-day Yukon Territory.

In 1790 Pond sold his share in the North West Company to Simon MacGillivray for £800, and retired to live in Boston. In 1785 and in 1790 he had drawn maps of interior Canada. The earlier of these two maps was known to Turnor when that Hudson's Bay Company official was engaged with Peter Fidler in a mission to survey Lake Athabasca in 1791. It is reported that the United States boundary commissioners, at the turn of the century, resorted to Pond's unique knowledge of Canadian geography to support their case for a boundary line along the St. Lawrence River and through the middle of the Great Lakes to the Lake of the Woods. Pond died in Milford in 1807.

The year before Pond retired to Boston, Peter Fidler (1769-1822) born in Derby, England, arrived as a Hudson's Bay Company employee at York Fort. The following summer Fidler was chosen by Philip Turnor to accompany him on the journey to Lake Athabasca. Both Fidler and David Thompson had been trained in surveying by Turnor. Both were well qualified for this exploratory task but Thompson had met with a serious accident a few days before Christmas, 1788. About a mile from Manchester House on the Saskatchewan River, Thompson, while hauling a sledload of firewood, slipped and fell down a river bank, breaking his leg. For many months he was on crutches. Even in February, 1790, "his leg [was] still bad".

From the time that Fidler wintered among the Chipewyan Indians on Slave Lake, he enjoyed the reputation of being an enterprising, perceptive and resourceful traveller. He wrote an excellent passage on the origin of the Kettle Portage potholes. Before reaching the great rapids Fidler crossed Kettle Portage (June 21, 1792) and observes, " . . . several very round holes of a cylindrical form, from 1 to 5 feet in diameter, perfectly smooth and round, a stone within loose—that served to make the excavation by the falling waters and strong current moving the stone, and by its friction causing those kind of stone kettles, above-mentioned, these having been formed when these places have been the bottom of a river, now the rocks are above the surface 4 to 5 feet".[16]

In 1800 Fidler led a party up the South Branch of the Saskatchewan. In 1802 he moved north to Lake Athabasca and in that same year sent a map to A. Arrowsmith in London to aid in the delineation of North America. There is reason to believe that Alexander Dalrymple was aware of Fidler's mapping work and ability. In 1796, four years after Turnor's retirement, Fidler was made chief surveyor and map maker of the Hudson's Bay Company, carrying on in these capacities until the union with the North West Company in 1821.

When Lord Selkirk established his colony on the Red River, Peter Fidler was employed in 1813 to make the first formal property surveys of Canada's western interior.[17] The two rivers, Red and Assiniboine, as they approached their junction, formed natural base lines for the division of land. Governor Miles Macdonell, first governor of the colony, was familiar with the river-lot system in Lower Canada and regarded it as a model or pattern for the initial Red River survey. But the lots were made one-third wider for greater convenience.

On July 17, 1813, Macdonell wrote to Lord Selkirk: ". . . I have since laid out lots of 100 acres, of 4 acres front on the river, according to the annexed rough sketch . . . The farms of Lower Canada are on 3 acres front, and the first settlers in Upper Canada had only the same, but they found it afterwards too narrow, which induced me to add one acre additional to the breadth of our lots here. This [is] sufficient for any . . . farmer".[18]

Lord Selkirk advocated a more compact type of settlement but this was never established, the river-lot system prevailing. Thus more than a thousand miles from the St. Lawrence Basin, history repeated itself. Talon and Colbert had suffered a similar reverse in New France of the 17th century. By 1870 river lots extended for more than 40 miles along the Red, and along the Assiniboine as far as Portage la Prairie. Most of the lots were laid out with a 12-chain river frontage but there were later variations all the way from 1 chain to a half-mile in width.[19]

In 1814 Fidler laid out a total of 36 lots along the Red and was recommended for appointment as permanent surveyor of the colony at £100 a year and office accommodation. The recommendation was contained in a letter written that year by Miles Macdonell to Lord Selkirk in which he stated, "We require to have a permanent surveyor who will keep a regular office and Mr. Fidler might answer the purpose. His Indian family is some objection to him. He is far from being a well-polished man and is not well liked by the people but I think him a well meaning man. I set off tomorrow for York. Mr. Fidler takes charge of matters here until my return". When Point Douglas, a peninsula formed by a bend in the Red River about a mile north of its junction with the Assiniboine, was subdivided into lots in 1817, it was Peter Fidler who made the survey. This step was taken to prepare for the settlement of some 100 disbanded soldiers after the war with the United States, probably the first soldier settlement project in Canada's West.

Fidler, who served for a time on the Council of Assiniboia, purchased five cows and an additional bull from the North West trading post at Fort la Souris, in order to augment the colony's tiny herd of cattle. The bull proved too vicious for handling and had to be slaughtered. During the 1813-14 winter a bull named Adam fell through river ice and vanished. But Adam had left a healthy son and heir before making his abrupt departure. Today Manitoba's cattle population (Dominion Bureau of Statistics 1963 figures) is more than 1,065,000, valued at more than $150,000,000.

In the Public Archives of Canada, Map Division, there is a large map drawn by Fidler and published 5 years after his death. This is an excellent cartographic representation of the western and north-western areas of Canada, as comprehended in his time.[20]

Peter Fidler is the author of one of the strangest wills ever to be drawn in Canada. Dated August 16, 1821, at Norway House (when Fidler was 51) the will provides that all his journals and maps be left to the Hudson's Bay Company; his library of 500 books and survey instruments to the governor of the Red River Colony.[21] After making provision for his Indian wife and 10 surviving children (14 children had been born to them) he disposed of his estate residue in the clause: "All my money . . . to be placed in the public funds and the interest annually due added to the capital and continue until August 16, 1969 (the 200th anniversary of his birth) when the whole amount . . . [shall be] placed at the disposal of the next male child heir in direct descent from my son, Peter Fidler". The fact that no Fidler money has ever been uncovered does not detract from the remarkable nature of this curious bequest.

At Meadow Lake, Saskatchewan, there is a National Historic Sites plaque inscribed: "Peter Fidler, Meteorologist and Surveyor. Served the Hudson's Bay Company actively for 34 years, trading on the North and South Saskatchewan and the Churchill rivers, built the fur posts Chipewyan 1791, Bolsover 1799, Greenwich 1799, Chesterfield 1800, Nottingham 1802. Made the first boundary survey of Assiniboia and surveyed Kildonan. His extensive Journal fully reflects the life of the land. Born at Bolsover, England, 16th August, 1769. Died at Norway House in 1822".

Fidler's successor as surveyor to the colony was a Scotsman, William Kempt, also appointed Sheriff. In 1822 he was instructed by the colony's governor to resurvey the lots laid out by Fidler and then to lay out lots* on Image Plain, some 10 miles north of Point Douglas. Kempt later returned to Scotland to continue the practice of land surveying there.

The next surveys of record were made by George Taylor in the years 1836 to 1838 inclusive. His work covered all previous surveys and was known as the *Old Settlement Belt Survey*. Taylor was surveyor to the colony from 1836 to 1844. He surveyed at least 1,542 lots along the Red and Assiniboine rivers. This basic Taylor cadastral plan became the foundation of all Hudson's Bay Company land grants in the Red River Settlement.

In June, 1855, the Council of Assiniboia appointed William Inkster as public surveyor at a salary of £25 a year with authority to charge as much as 7s.6d. a day for every day he was employed in his official capacity. In May, 1856, the Council appointed a second public surveyor. This was Roger Goulet (1834-1902), born in the Settlement in 1834. During the Red River troubles of 14 years later he was imprisoned by Louis Riel for refusing to cooperate and to accept a surveyor's office under him. In 1860 Herbert L. Sabine was engaged as a surveyor on terms similar to the arrangements made with Goulet. His area for surveying was the north side of the Assiniboine River.

Born in Stornoway, Scotland, Alexander Mackenzie (1764-1820) was brought by his parents to New York. During the troubled years leading up to the American Revolution young Mackenzie was sent to Detroit to learn the fur trade. His abilities, inquisitive mind and enterprising spirit soon thrust him into prominence and when John Ross died, as a result of an altercation with Peter Pond, Mackenzie was sent to replace him. Mackenzie and Pond were on fairly amicable terms during the winter of 1787-88 at Fort Chipewyan. Pond enlightened the ambitious Scot on conditions and the lay of the land farther north, matters on which Pond possessed first-hand knowledge. The concept of a large westward-flowing river emptying into the Pacific still governed the minds of men in that age and Pond was no exception. It did not seem to occur to anyone that such a river would need to take its rise on the western slopes of the intervening Rockies. Thus Pond had convinced himself that the important river he had observed leaving Great Slave Lake and flowing westerly, reached Cook's 'River' in Alaska, which had been discovered in the same latitude as Great Slave Lake and news of which had been circulating in North America since Cook's third voyage. Pond chose to disregard information given him by Indians that the great river finally turned northward. Mackenzie was misled by

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*8 lots of 32 acres each.

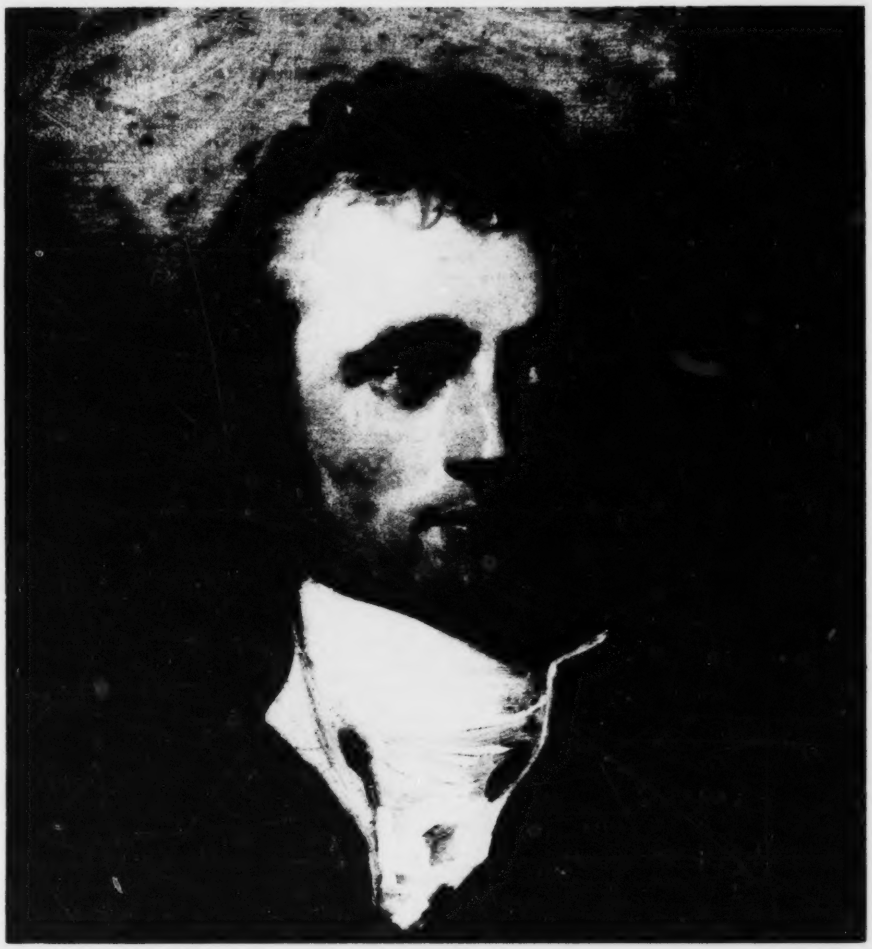


FIGURE 22. Alexander Mackenzie.

Pond's theory in this respect but undoubtedly he owed much to the latter's experience and practical advice in planning and executing a major journey of exploration.

An odd aspect of Mackenzie's character was his cold contempt of Pond to whom he owed so much for the ultimate success of his explorations. On the credit side of his personal ledger Mackenzie maintained excellent relations with his crewmen and with the Indians he met. The fact that none of his men was killed and none deserted him on these prolonged, arduous and hazardous ventures into the unknown, is in itself eloquent of Mackenzie's ability to win people to his viewpoint and to communicate his enthusiasms.

At 9 o'clock on the morning of June 3, 1789, Mackenzie set out from Fort Chipewyan well equipped for a bid to find the Western Sea. This was the dream that continued to cast a spell over adventurous Europeans. It was difficult in those days to grasp the possibility that a continent that was so narrow at Panama, could be so vastly wide farther north. The discovery of any navigable water passage from the continental interior to the western coast would mean enormously increased profits to fur traders because of the provision of cheaper marine transport for their goods.

So well equipped was Mackenzie on that June day in 1789 that he had with him roubles for trading with the Russians. Accompanying him were 12 men and women, including four French-Canadians (two of whom had brought their wives), a German, an important Indian called English Chief, followed in a second canoe by his two wives, and by two of his tribesmen in a third canoe. The Indians were to perform as hunters and interpreters. Mackenzie pushed all of them to the very limits of their physical endurance. They started out each morning at sunrise, making camp in the late afternoons. Cold weather, heavy rains and clouds of tiresome flies failed to discourage him. The Indians, however, complained bitterly. Among themselves they must have frequently questioned Mackenzie's sanity.

Mackenzie himself experienced profound disappointment when he found the river, which now bears his name, turning northward and being flanked to the west by a continuous mountain barrier, a northern extension of the Rockies. When the sun did not set at midnight Mackenzie realized that he was within the Arctic Circle. On the night of July 12 the party, in a state of near panic, had to move quickly to prevent their baggage from being submerged in rising water. This was the first convincing clue Mackenzie had that he was now at tidewater. This clue was confirmed when he took observations for latitude and for compass variation on July 13th.

Mackenzie and his party returned safely to Fort Chipewyan on September 12, after travelling more than 3,000 miles in 102 days. The explorer was undaunted by his failure to reach the shores of the Pacific but he had effectively demolished Peter Pond's theory that the big river emptied into Cook's 'River'. However, nowhere along his extensive route had Mackenzie been able to establish his position in terms of longitude and he planned to improve his knowledge and capacity in this field in the near future.

Mackenzie left Lake Athabasca in the spring of 1791, bound for London, England. "I resolved", he said, "to improve my knowledge of surveying and navigation [in order] to return to find a passage through those western mountains". On his way east he met Philip Turnor who was en route to make surveys for the Hudson's Bay Company at Fort Chipewyan, and, in particular, to establish its longitude. The position of Hudson Bay, in terms of longitude, had been determined and Turnor's purpose was to find the exact mileage between the Bay and Fort Chipewyan. When he finally determined the fort's longitude the true distance of the post from the Pacific Ocean was realized for the first time.

Alexander Mackenzie spent the winter of 1791-92 in London, learning sufficient astronomy to fix longitudes and to purchase required instruments, a compass, sextant, chronometer and telescope, as well as the most recent astronomical tables. He sailed from London on May 9, 1792, and set out from Fort Chipewyan on his celebrated journey to the Pacific on October 10, 1792, returning in the autumn of 1793. Despite his training Mackenzie usually underestimated distances on his trip. His compass bearings seem uncorrected for magnetic variation (which is about 23 degrees east in the latitudes of his route and in his times). In addition to other troubles he had the misfortune to damage his 'Farenheit' thermometer early on his westward journey. The instrument was rendered useless and Mackenzie's diary from that point on suffered from a lack of reliable meteorological information. He and his party followed a generally southwesterly direction, ascending the Peace River to Finlay Forks. There he wisely chose the less inviting Parsnip River, rather than the Finlay River. Had he used the latter, it is not likely that he could have reached the coast.

On May 11, 1793, Mackenzie notes in his Journal, "Took meridian altitude which gave 55.56.3N lat.". Again, on May 29: "Rain so violent all day . . . that we did not venture to proceed. As we had almost expended the contents of a rum keg, and this being a day which allowed of no active employment, I amused myself with the experiment of inclosing a letter in it . . . [the keg] . . . dispatching it down the stream, to take its fate . . . consigned . . . to the mercy of the current".

Soon he passed over the Continental Divide into a strange entirely new world of high mountains and dangerous rivers.[22] He descended the peril-filled Fraser (which he thought was the Columbia) from near present-day Prince George, leaving the river in the vicinity of Williams Lake and striking westward to the Bella Coola River and eventually tidewater at North Bentinck Arm, one of the inlets of the ocean penetrating deeply into the North Pacific Coast. The ten men of the party had only 20 pounds of pemmican, 15 pounds of rice, 6 pounds of flour and a little ammunition left. June 25: "I now had a meridional altitude, which gave 60.23 natural horizon [the angle being more than the sextant could measure with the artificial horizon] . . . and the eye five feet above the level of the water gave 52.47.51 North latitude. During our stay . . . we had been most cruelly tortured by flies, particularly the sand fly, which I am disposed to consider as the most tormenting insect of its size in nature".[23]

It was absolutely essential that Mackenzie establish his position geographically if his discoveries were to hold any real meaning for the outside world. He needed a long stretch of open water in order to provide a natural horizon, and a clear sky at the right time for making observations of the sun and of Jupiter's satellites. It was not easy in this region to obtain the exact combination of favorable factors. Members of his party were disgusted when he showed dissatisfaction with Bella Coola village on North Bentinck Arm as a tidewater destination of the long, hard journey overland. Against all protests he ventured along the Arm in a light craft, taking occasional pot shots at elusive sea otters. He rounded Points Menzies and Edward, reaching Dean Channel and a rock formation near Elcho Harbor, not far from present-day Ocean Falls.

July 22: "My instruments being exposed they (the Indians) examined them with much apparent admiration and astonishment. My altitude, by an artificial horizon, gave 52.21.33; that by the natural horizon was 52.20.48 N. lat.". Mackenzie took a number of sightings and after observing the eclipses of the first and third satellites of Jupiter, produced an average of these observations and fixed his longitude at 128.2 West of Greenwich.[24] This reading was about 42 minutes of arc short of accuracy, or about 30 miles in error. In fixing latitudes for his inland positions Mackenzie achieved much greater accuracy, being generally a little more than a mile in error. These considerations become of some importance when one reads in Mackenzie's Journal (page 441): "I had now determined my situation, which is the most fortunate circumstance of my long, painful and perilous journey, as a few cloudy days would have prevented me from ascertaining the final longitude of it." Then he set down the now-famous words: "I now mixed with some vermilion in melted grease, and inscribed in large characters on the South-East face of the rock on which we had slept last night, this brief memorial: 'Alexander Mackenzie, from Canada, by land, the twenty-second of July, one thousand seven hundred and ninety-three'."[25]

Mackenzie's recorded observations have produced much controversy among surveyors and geographers concerning the exact place on which the inscription, long ago erased by the elements, was made. Capt. R. P. Bishop, B.C.L.S., has made a special study of this feature of the Mackenzie epic.[26] He points out: "this [type] of observation (observing eclipses of Jupiter's satellites), the simplest of the absolute methods and one in common use even for scientific purposes a few years before Mackenzie's time, cannot be depended upon to give very accurate results, as the eclipses are not instantaneous and the exact time . . . of the disappearance and re-appearance of the satellites is difficult to determine".

Raper's *Navigation* states that the observation is only to be considered complete where both disappearance and re-appearance of the same satellite are observed on the same evening under the same circumstances. Mackenzie had a telescope which was probably not up to the standard deemed necessary by Raper . . . "In comparing results of Mackenzie's necessarily crude method with those obtained by skilled observers carrying the best equipment England could produce, we find Vancouver's determination of longitude at Nootka differed from that of Cook by 20 minutes of arc".

The coast hills were hidden in fog and a strong head wind had to be bucked by Mackenzie as he entered the arm of the sea in his frail craft that July morning. But he added a key piece to the geographic jig-saw puzzle that had for so long baffled explorers of North America. By his history-making journeys Mackenzie had replaced myth, dream and rumor by solid facts. He had explored the entire length of one of North America's largest and longest rivers (and certainly Canada's greatest) and learned that it did not discharge into the Pacific as had been almost universally thought. He was the first European to reach the Pacific by land from the east and he learned much about the rugged and extensive terrain existing all the way from the northwestern interior to the Pacific coast. His return trip to base was a very rapid one, consuming only 33 days. If only Canada's earliest fur traders and explorers had realized soon enough that the Fraser was not navigable for much of its upper reaches and that *it* was *not* the Columbia, the main Canadian effort to explore and settle might have been directed farther south and thus established British possession of the Oregon Country before the Americans reached it.[27]

Mackenzie's achievements had other interesting and historically important results. It is said that Lord Selkirk read Mackenzie's *Voyages* and its contents inspired in him the idea of colonizing the Red River valley. There is no doubt that Mackenzie himself sparked Lord Selkirk's interest in the Hudson's Bay Company. Above all, Mackenzie's superb example led to the expansion and ultimate settlement of vast portions of Canada's north and west. And he settled for all time the question whether or not there existed a natural, navigable water passage across the middle of North America.

In 1801 Mackenzie's *Voyages* was published and in 1802 he was knighted. From 1804 to 1808 he sat in the Assembly of Lower Canada as member for Huntingdon in the Eastern Townships. He left Canada in 1808, never to return.

Philip Turnor (1751-1800) is not credited with any significant geographical discoveries but has some claim to fame as the first scientific observer to work actively in the western interior of Canada. He prepared many maps of the country between James Bay and Great Slave Lake but his greatest contribution to Canada's development was in training David Thompson and Peter Fidler in the sciences of surveying, mapping and the making of field notes. Turnor was first brought to Canada in 1778 by the Hudson's Bay Company as a trained surveyor. He returned to England nine years later. His final visit to Canada was for a period of three years, commencing in 1789.

In his early years in this country Turnor worked mainly in the proximity of Hudson and James Bays. In 1790-92 he journeyed from York Fort to Cumberland House, then to Lake Athabasca and back to Hudson Bay. The map he prepared of the land traversed is the first map of Canada's western interior to give reliable indications of the nature of its topography. His journal was finally published in 1934.

By 1763 the Canadian West known best to geographers included the large lakes in what is now the province of Manitoba, the west coast of Hudson Bay and the Assiniboine River valley as well as the prairies extending between the Assiniboine and the Missouri. There was knowledge also of a chain of high mountains somewhere beyond the Saskatchewan River forks. There was an awareness, too, of extensive prairie grasslands to the south and west of the forks. But no coherent map or description of the western interior had been produced up to the late 18th century. This serious lack of cartographic representation of Canada's West was to be remedied in the closing years of that century and during the opening years of the 19th century by a man who later became widely regarded as the greatest land geographer of his day in British America and the maker of the first comprehensive map of the Canadian West. This latter achievement may, in the long future, represent David Thompson's chief claim to enduring fame.

Born in London on April 30, 1770, David Thompson (1770-1857) was the son of David and Ann Ap-Thomas, a surname that was changed when the Welsh couple moved to London. Young David was left a foundling and was enrolled at 7 years of age in Grey Coat School, near Westminster Abbey. He remained a pupil there for seven years (1777-1784). There he was taught from such books as Atkinson's *Art of Navigation*, Newton's *An Idea of Geography*, and Barlow's *A Survey of the Tide*. Towards the end of 1783 the Hudson's Bay Company, then more than 100 years old, applied to the school to ascertain "if the Charity could furnish them with four boys against the month of May next, for their settlement in America". Apparently David Thompson was the only lad then available for the purpose. He had early shown a talent for drawing and a special interest in geography. The 14-year-old David arrived at Fort Churchill aboard the Hudson's Bay Company ship *Prince Rupert* in early September, 1784. This was the year of the Loyalist influx in the settled parts of Canada, and very shortly after the flight from Shelburne of the unappreciated surveyor, Benjamin Marston.

One of the first tasks assigned to the newly-arrived clerk was the copying by longhand of the account of the journey of Samuel Hearne to the Coppermine River. At the time Hearne was Governor at Churchill. Following upon the leg fracture Thompson sustained just before Christmas, 1788, in an accident already recounted, he was carried to Cumberland House to be treated by the Resident Surgeon. In the following year Thompson lost the sight of his right eye. But it was at Cumberland House that he met the company's official surveyor, Philip Turnor, and under his tutelage studied astronomy, geography and practical surveying during the winter of 1789-90. In addition he was carefully taught the survey uses of the telescope, chronometer, compass and thermometer. He learned to employ a sextant (10-inch radius) made by Dolland of London as well as the *Nautical Almanak* and the artificial (mercury) horizon. He was taught how to sight on the sun and stars and how to establish latitudes and longitudes of positions and places. About this time Thompson began also to use a notebook, to keep records regularly and to keep track of his meteorological observations. These were made several times daily, the direction and force of the winds were recorded as well as general remarks of prevailing climatic conditions. Thompson's later notes exhibited an insatiable curiosity concerning North American wildlife. Throughout his *Narrative* are to be found many descriptions in detail of the appearance and habits of birds and animals. In addition there were parts of vocabularies of various Indian languages that he learned to speak in the wilderness.

Young Thompson gained in this way dependable grounding in the theory and practice of surveying. It was during this apprenticeship period that he took a series of astronomical observations, six of them for meridian altitudes of the sun, in order to establish latitudes of the locality, and 35 lunar observations for longitude readings. He estimated that Cumberland House was 53 degrees, 56 minutes, 44 seconds north latitude and 102 degrees, 13 minutes west longitude. This calculation is nearly identical with the position of the place as shown on modern maps. With the coming of summer Thompson was sufficiently recovered from the effects of his accident to make the trip to York Factory. During this 750-mile journey along the canoe route he made a map of what he traversed. The map was sent to the London directors of the company on the next ship leaving York.

One of the probes made by the Hudson's Bay Company into the interior from Churchill involved a youngster, George Charles, who was expected to seek out a practical canoe route to the Athabasca country from the Bay. Charles, like Thompson, was a Grey Coat School apprentice. He had been sent out to the Bay in response to Alexander Dalrymple's pressure for the appointment of surveyors. But his training had been perfunctory and his heart was neither in the tasks of exploration nor in the practice of surveying. Thompson reports: "When he landed at Churchill, age 15, I saw him and inquired how he came to undertake the business, he told me he had been about one year in the mathematics school, had three times with a quadrant brought down the sun to a chalk line on the wall—was declared fully competent and sent out to go on discovery. Of course, nothing came of it".[28] For the remainder of his American career, Charles became more of a trader and less a surveyor.

So keen was Thompson's interest in surveying that instead of asking the company stores for clothing to which he was entitled, he requested a brass sextant. At a later time, writing to a friend, Thompson referred to his sextant as a constant and loved companion. Surveying was to him his chief pleasure and life work. Joseph Colen, Resident Chief at York, stated, "Thompson, a deserving young man and in morals and behaviour worthy of imitation . . . for I have never heard him use an indecent expression, or smoke a pipe . . . the most correct observer I have seen in this country".[29]

Thompson spent the year 1791 at York Factory. He had reached the age of 21 and his seven-year apprenticeship had been completed. In a new 3-year contract which he signed with the company it was stipulated that he was employed as a "Surveyor and Trader". But the appellation did not quite fit. Thompson, by nature, was a scientist, not a salesman. In 1792 he ventured into the muskrat country west of the Nelson River, between the Saskatchewan and Churchill Rivers. In 1796 he travelled with two young Chipewyan Indians to search out a canoe route, Churchill to Athabasca. The party made their own canoe, then set off on June 10 equipped with a fishing net, a gun, ammunition, flints and some powder. They reached the eastern end of Lake Athabasca on July 2. On his return trip Thompson survived exceptional perils and privations. On one occasion his canoe overturned in rapids and he was nearly drowned. Thompson, as a result, was left in the wilderness with only his gun, an axe, pewter basin and a small tent. Possessing but a shirt and thin vest he travelled naked from the waist down. A torn foot was bound up in a piece of tent cloth. But his precious sextant and papers, secure in a cork-lined box, were later recovered from the water. It was during such experiences that Thompson developed unusual skills as a hunter.

At the end of the harsh winter of 1796-97 Joseph Colen advised Thompson that "however extensive the countries yet unknown, I cannot sanction any further surveys".[30] Thompson, in 1794, must have signed a second three-year contract with the company because when Colen's uncooperative attitude towards his surveying activities proved too much for Thompson to endure, he decided to leave the Hudson's Bay Company and enlist with the rival North West Company. At the time Thompson was being paid £60 a year supplemented by a bonus for 'inland service'. His main grievance appears to have pertained not to rates of remuneration nor to working conditions but simply to the fact that he could see no real future with the H.B.C. for the travelling and surveying he felt compelled to do. Accordingly, on May 21, 1797, Thompson left Bedford House and walked 75 miles to Fraser House, the nearest North West Company post, located at the outlet of Reindeer Lake.[31]

At this critical stage in his career David Thompson made some cogent remarks on the mapping work of Peter Pond. "At Lake Superior he procured a compass, took the courses of the whole route to his wintering place . . . sketching off the lake shores as best he could. In the winters . . . he constructed a map of the route followed by the canoes. Its features were tolerably correct; but by taking the League of the Canoe Men for three geographical miles [I found they averaged only two miles] he increased his longitude so much as to place the Athabasca Lake at its west end near the Pacific Ocean".[32] This palpable error resulted in the company bringing Philip Turnor back from England to ascertain the precise position of Fort Chipewyan. Following the completion of this project the Hudson's Bay Company remained relatively dormant for some years in the field of exploratory surveys.

When the high officers of the North West Company learned of Thompson's defection to their firm he was cordially welcomed. His special abilities and sterling character were well known to them. He was engaged at once as a "Surveyor and Map Maker" and, in particular, to (1) Determine the exact position of the 49th parallel of latitude; the new boundary between the western part of British North America and the United States under the 1792 treaty; (2) To ascertain the positions by latitude and longitude of the North West Company trading posts in relation to that boundary; (3) To visit the villages of the Mandan Indians on the Missouri river to promote trade; (4) To search for fossil bones of large animals.

Not long after he entered the services of the North West Company, and after he had completed the surveying of the south shore of Lake Superior, Thompson encountered Alexander Mackenzie in a surprise meeting at Sault Ste. Marie. Mackenzie paid his fellow Nor'Wester a resounding tribute. "Thompson", he told his travelling companions, "has accomplished more in ten months than the company had expected would be done in two years". In those ten months he had surveyed more than 4,000 miles of practically unmapped territory and this during the most difficult seasons of the year. Truly, a remarkable record of work!

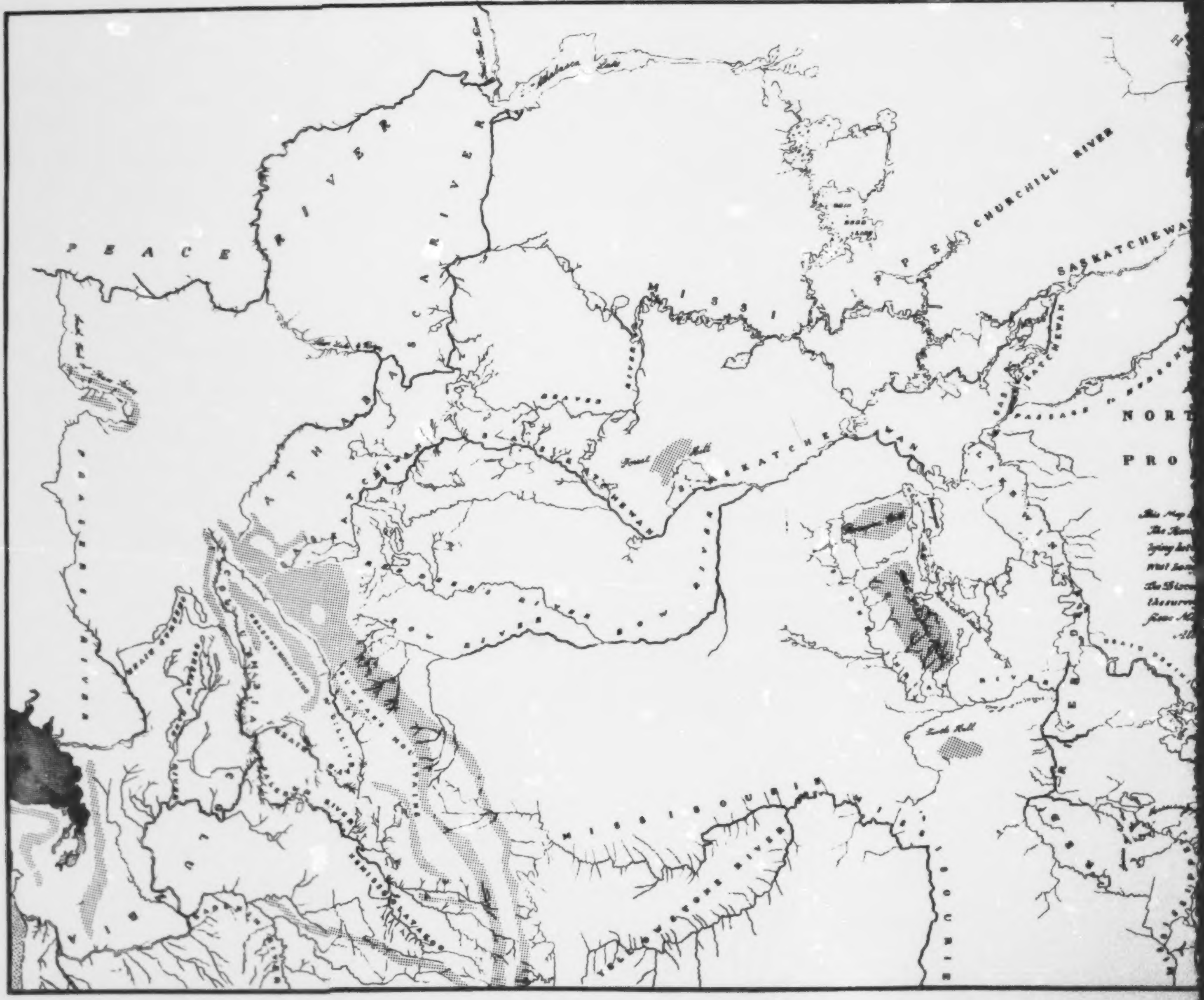
Eight years after joining the North West Company Thompson married Charlotte Small, an Indian woman, on June 10, 1799, at Isle-à-la-Crosse. The Manitoba surveyor-historian H. E. Beresford has pointed out some natural consequences of this act. "David Thompson, as did so many Hudson's Bay Company employees of the time, married an Indian girl. She, along with several of her relatives, accompanied the explorer on his travels. They took little provisions with them as it was expected that while David Thompson carried on his mapping and surveying activities, the rest of the party would hunt and fish . . . There were many complaints of the long hours and great hardships, so that Thompson, in his exploring zeal, sacrificed not only himself, but all his wife's relatives"![33] A man of this calibre obviously deserved recognition, if not achievement, and on July 10, 1804, Thompson was made a partner in the North West Company, at the age of 34.

In twenty years David Thompson had come a long way in the New World. When he left the Hudson's Bay Company he was bitter in his condemnation of Colen, writing to the latter to state that he suspected Colen to be the one responsible for cutting off his supplies of books from England as well as of letters of approbation from London, and even of robbing him of his *Nautical Almanak*, so essential to any surveyor of his day. He pronounced a severe verdict upon Colen complaining that "from your peculiar manner of conduct, you are also one of those unfortunate men who will have many an acquaintance but never a real friend".[34] Thompson charged that the company directors were lethargic and indifferent, that the company did the least possible work in surveying and exploring, and did that only under heavy pressure from Alexander Dalrymple, Admiralty Hydrographer. The letter, a gesture as gratuitous as it was ineffective, was written in anger rather than out of good judgment. In any event, in later years, Thompson's views of Colen mellowed considerably. In chapter ten of his *Narrative* Thompson stated, "I had explored under the sanction of Mr. Joseph Colen, the Resident at York Factory, the most enlightened gentleman who had [ever] filled that situation".[35]

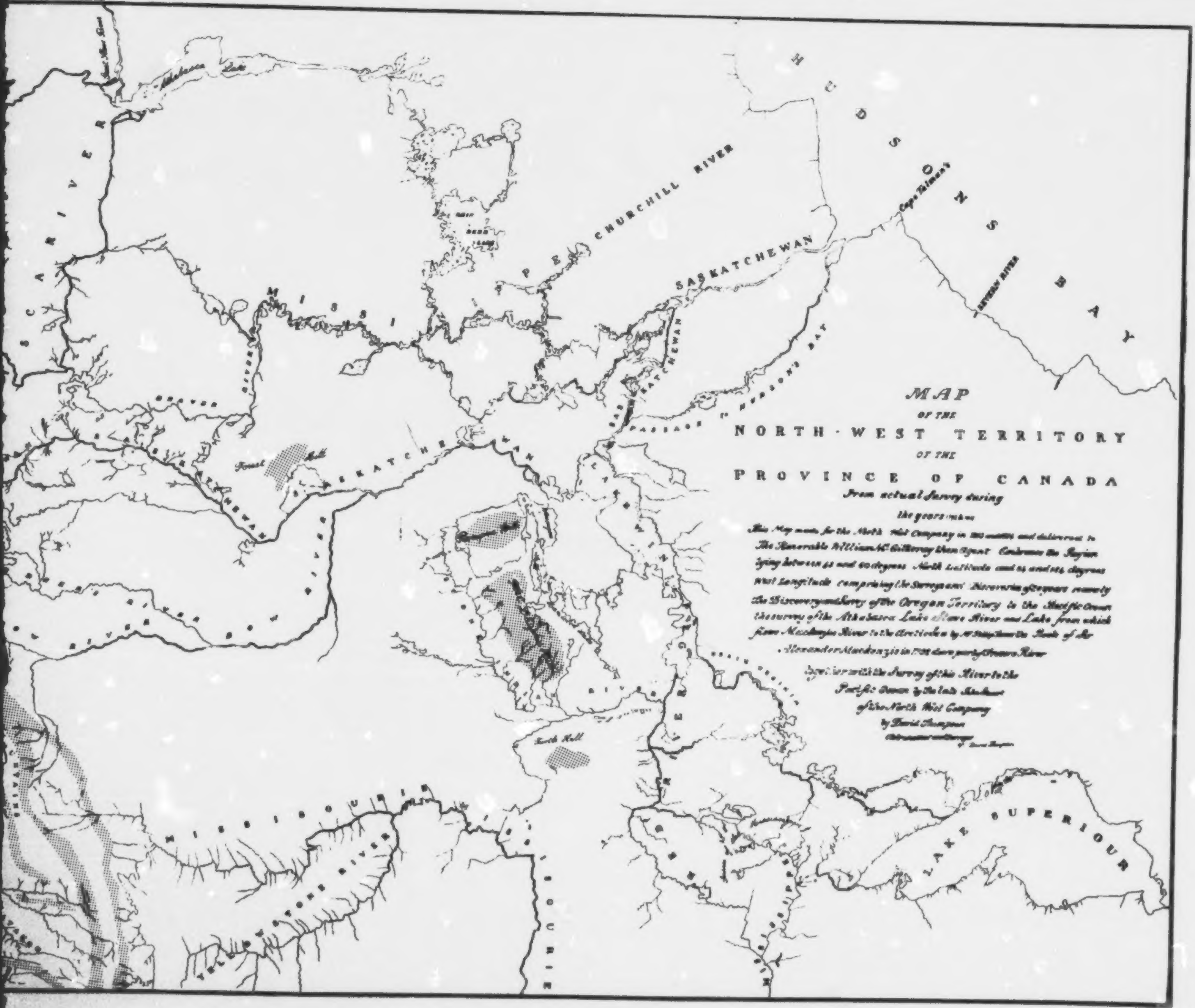
Thompson's difficulties in the field were serious enough. "To ascertain the height of the Rocky Mountains above the level of the ocean had long occupied my attention but without any satisfaction to myself. I had written to the late Honourable William McGillivray to buy for me a mountain barometer for the measurement of these mountains; he procured for me such a barometer which he placed in the hands of a partner, Mr. J. McDonald, with a promise to take great care of it and deliver it to me in good order. But he tossed it on loaded canoes where it was rolled about and when he brought it to me at the foot of the mountains, the case was full of water and the barometer broken to pieces. Mr. McGillivray bought for me another barometer, which unfortunately was delivered to the same person who made the same promises, with the same performance. Seeing it was hopeless to procure a barometer I had to follow the best methods of measurement which the circumstances allowed. By a close estimate of the descent of the Columbia River from its source to the sea I found it to be 5,900 feet in 1,348 miles, an average of 4 feet, 5 inches per mile. . . ."[36]

Base lines were carefully measured and the angles of the height taken with the sextant in an artifical horizon of quicksilver. By this method Thompson found the altitude of Mount Nelson to be 7,223 feet above the level of Kootenay Lake which gave 13,123 feet above Pacific tidewater.[37]

The Indians among whom Thompson travelled never ceased to marvel over the antics of this strangely acting white man, whom they came to call "Koo-Koo-Sint", man who looks at the stars.[38] In his *Narrative* Thompson points out, "Canadians of my party and Indians often inquired of me why I observed the Sun, and sometimes the Moon, in the day time and passed whole nights with my instruments, looking at the moon and stars. I told them it was to determine the distance and direction from the place I observed . . . to other places; neither the Canadians nor the Indians believed me; for both argue that if what I said was the truth, I ought to look to the ground and over it, and not to the stars. Their opinions were that I was looking into futurity and seeing everybody and what they were doing; how to raise the wind, but they did not believe I could calm it. One fine evening in February two Indians came to trade; the Moon rose bright and clear, with the planet of Jupiter a few degrees on its east side; and the Canadians as usual predicted that Indians would come to trade in the direction of this Star. To show them the folly of such predictions I told them the same bright star, the next night, would be as far from the Moon on its west side; this, of course, took place from the moon's motion in her orbit; and is the common occurrence of almost every month, and yet all parties were persuaded I had done it by some occult power to falsify the prediction of


PEACE RIVER
ATHABASCA RIVER
Athabasca Lake
CHURCHILL RIVER
MISSI
SASKATCHEWAN
SASKATCHEWAN
NORT
PRO
BOW RIVER
MISSISOURI
YELLOWSTONE RIVER
MISSOURI
COLUMBIA

MAP 28. David Thompson's map of the North West Territory of the Province of Canada, 1792-1812. Reproduction in this form by courte
Champlain Society, Toronto.



MAP
OF THE
NORTH-WEST TERRITORY
OF THE
PROVINCE OF CANADA
From actual Survey during
the years
by David Thompson
HUDSONS BAY
Cape Tatnam
SEVERN RIVER
CHURCHILL RIVER
MISSISSIPPI
SASKATCHEWAN
HUDSON'S BAY
Athabasca Lake
RIVER
SASKATCHEWAN
BOW RIVER
Forest Hill
Turtle Hill
MISSISOURIE
YELLOWSTONE RIVER
LAKE SUPERIOUR
MISSISSIPPI

hompson's map of the North West Territory of the Province of Canada, 1792-1812. Reproduction in this form by courtesy of the
y, Toronto.

the Canadians".[39]

Thompson crowned a series of years spent mainly in the mountain areas of the West by travelling in 1808-09 to establish trading posts in what is now southern British Columbia, Idaho, Montana and Oregon. He discovered the Mayie Trail and Pend Oreille Lake. In 1810 he discovered (Athabasca) Yellowhead Pass through the Canadian Rockies and reached the Columbia River in January, 1811. Later that same year he descended the Columbia to its Pacific outlet, reaching Fort Astoria on July 15. He found that the Astor expedition from New York via Cape Horn had preceded him by several weeks and its members were building a fort. He spent the following winter in what is now northern Idaho and Washington territory.

By 1813 he was ready with a mass of data, most of it the result of personal observations, to embark upon the most ambitious cartographic effort of his career, that of constructing a map of the western regions he had travelled. His assignments from the North West Company had given him unexcelled opportunities for exploration unhindered by commercial responsibilities. For this mapping project he was allotted three years by the company, during which period he was permitted to share in its profits. In order to concentrate on map drafting he settled with his family at Terrebonne, Quebec, where he registered as a land surveyor. He required only two years to complete what was, for his time, a truly superlative achievement in the science of cartography.

Though it was proudly displayed in the boardroom of the Fort William headquarters of the North West Company, this Thompson map was never issued to the public. The fact that it was not distributed in any form may have been due to an inadequate number of potential subscribers or to the lack of a publisher with sufficient capital to handle it. It is possible also that the North West Company preferred, at the time, to retain the information the map portrayed for their own guidance rather than divulge it to business rivals. Thus the crowning accomplishment of this talented map maker brought him neither remuneration nor wide recognition. Forty years later, when the Geological Survey of Canada required a map of Western Canada, Thompson's was still the best available. In fact, as late as 1915, many maps published by the Canadian government, by railways and other agencies, were based on the cartographic work performed by David Thompson one hundred years earlier. Today the original map may be seen in the map room of the Public Archives in Toronto.

In 1815 Thompson moved to Glengarry county, Ontario, having purchased the Williamstown house of Reverend John Bethune (1751-1815), who had organized Upper Canada's first Presbyterian congregation in that village in 1787. With his family, consisting at the time of at least 13 children, Thompson and his wife lived in Williamstown until about 1835. This period was the happiest of his life, following retirement from fur company employment. For 10 years, from 1816 to 1826, Thompson was British representative on the international boundary commission established under the terms of the Treaty of Ghent. An atlas of maps made by him while serving as boundary commissioner is also to be seen in the map room of the Public Archives of Ontario. In these archives are Thompson's original journals, consisting of 38 numbered volumes and an unnumbered one.

Dr. John J. Bigsby, author of *The Shoe and Canoe*, at the time he acted as British Secretary to the international boundary commission, provides an interesting impression of Thompson's appearance. He first met David Thompson in William McGillivray's imposing Montreal home and was struck by the surveyor's simple, unaffected manner and innate dignity as he relaxed in the pretentious surroundings. "I was placed at the table", recounts Dr. Bigsby, "near a singular-looking person of about fifty. He was plainly

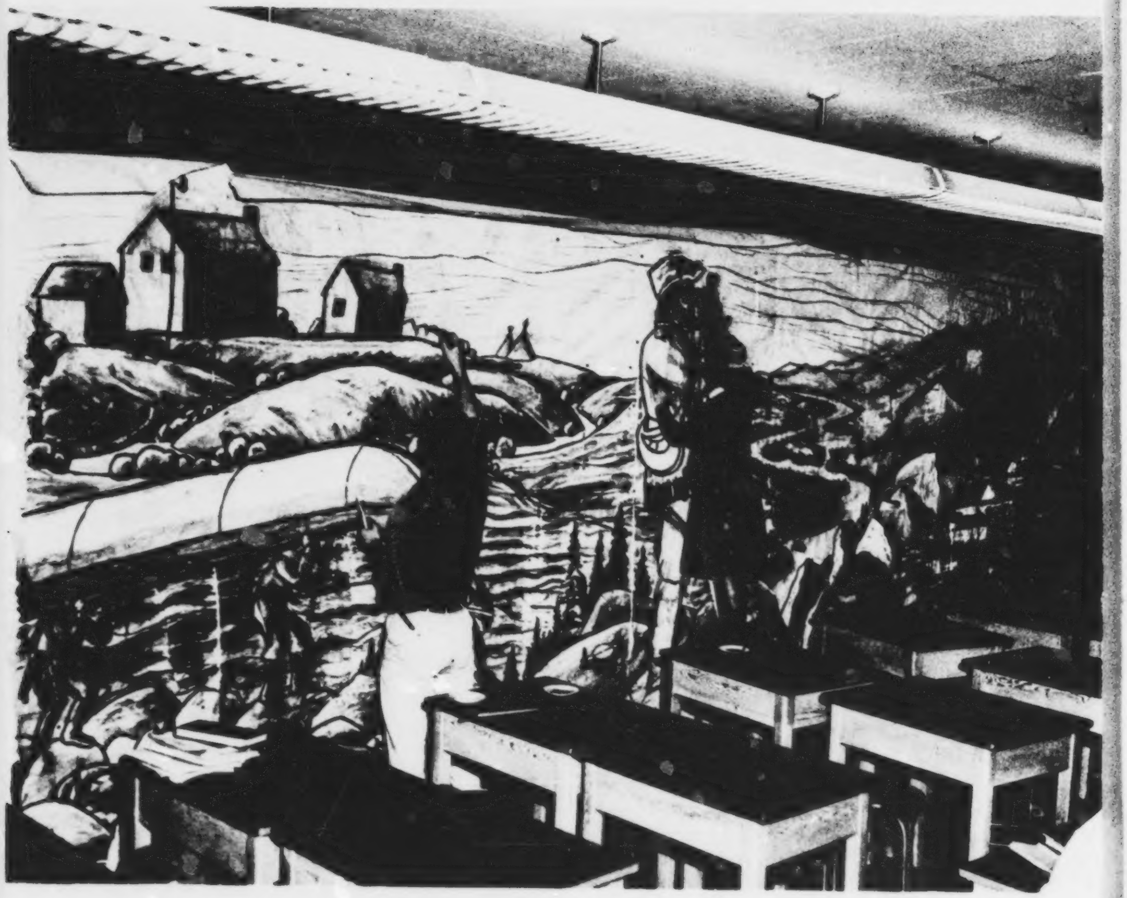


FIGURE 23. Students of David Thompson Secondary School, Vancouver, B.C., at work in a classroom on their Thompson mural.

dressed, quiet and observant. His figure was short and compact, and his black hair was worn long all round and cut square as if by one stroke of the shears, just above the eyebrows. His complexion was of the gardener's ruddy-brown, while the expression of his deeply-furrowed features was friendly and intelligent. But his cut-short nose gave him an odd look. His speech betrayed the Welshman. He greatly resembled Curran, the Welsh orator. . . ."

Following the termination of his work on the boundary Thompson began to experience severe economic reverses. He had readily advanced substantial sums to assist his children and undoubtedly his generosity resulted in a heavy drain on his financial resources. In addition he never refused to meet requests for money from veterans of the fur trade who approached him for help. Finally he felt compelled to move from Williamstown to Longueuil, on the south bank of the St. Lawrence across from the island of Montreal, in the hope of obtaining gainful employment. In this quest he was only moderately successful. Between 1833 and 1840, at a stage in life when most men would be preparing to retire, Thompson was surveying in the Muskoka district as well as the Lakes St. Francis and St. Peter (including the provincial line). In addition he was active in surveying parts of the Eastern Townships of Quebec and the canoe route from Lake Huron to the Ottawa River. In a report on his examination of the latter route, Thompson notes on November 11, 1837:

"Near noon we arrived at Mr. Alex McNaughton's establishment of two log houses and a sawmill in charge of Alexander McDonald, about five miles below the channel of the Calumet Falls . . . [December 6-7]. . . . Continued opening a line and taking the levels along the brook; but the thickets of willows and elders now became frequent, very tedious to open a line through, and we had to keep in the rising ground for a distance of 52 chains, 42 links, being 10 stations; the land good and for this distance with two slight undulations, may be said to be level, showing only a depression of two inches".[40]

From 1840 to 1842 Thompson executed surveys for the city of Montreal. In 1842 he accelerated his writing work on his *Narrative*. Meanwhile he carried on a lively correspondence with government officials and with editors concerning the Canada-United States boundary line. But he and his wife faced conditions of dire poverty. The sight of his remaining sound eye failed rapidly; he was forced to sell his most cherished instruments and to pawn his coat in order to obtain food. In the end Thompson and his wife became utterly dependent upon their children living in the Montreal area.

During these troubled years Thompson worked on plans to make his great map available to the public. For this purpose he prepared a prospectus addressed to those most likely to subscribe for it. "To be published in English by David Thompson", declared the document, "a new and correct map of the countries of North America situated between the parallels of 45 degrees and 60 degrees North latitude and extending in longitude from the east side of Lake Superior and Hudson's Bay, quite across the Continent to the Pacific Ocean, and from his own local knowledge, being the result of 22 years employment in discovering and laying down the several rivers, lakes, hills and mountains on this extensive tract. . . . The whole founded on astronomical observations, the author being an astronomer by profession. . . . The map will be engraved in a neat, chaste manner, combining elegance with economy, on the scale of three inches to one degree of Longitude. . . . He also offers to the scientific public, and of the same size as the General Map, a Chart to contain only the grand features of this part of the Continent . . . the position and extent of Coal Mines, of the various Beds of different kinds of Stone and Rock; of the great meadows and Forests. . . .".

Nothing, however, came of these almost pathetic ventures into the realms of publicity. David Thompson, the scientist, never succeeded as a salesman. Had his efforts in this direction been well received it is quite possible that the resulting financial returns would have made for the Thompsons all the difference between prosperity and penury.

Dr. Alex E. MacDonald, well-known map collector of Toronto, has in his possession a rare book, published in Montreal by Armour and Ramsay in 1850 and titled, *Anatomy, Physiology and Pathology of the Eye.* At page 357 of this volume as one of the cases of eye trouble listed by the author Henry Howard is that of "David Thompson, Surveyor and astronomer, led to my surgery by his daughter on February 24, 1848. Claimed to have been blind in right eye since February, 1789. Claims he woke up one morning so blind he could not tell daylight". All indications of his condition point to the onset of glaucoma, following an eye hemorrhage. Thus at the age of 78 darkness closed down on this remarkable man. He was totally blind for the last ten years of his life.

On this continent of North America no other man, by his own unaided labor, left such a legacy of combined discovery, surveying and mapping as did David Thompson. The Public Archives of Canada, Map Division, has catalogued more than thirty of his maps dated from 1817 on, including atlases of his international boundary maps. With his Celtic imagination and idealism, Thompson combined a fine practicality and accuracy instilled by English training. Tempering the vision and daring of the explorer was the cool calculation of a mathematical scientist. His outstanding characteristic was his ability to form, early in his career, a lofty concept of what could be accomplished and then to follow persistently in a long-term pattern of contributory activity in order to fulfil that purpose. It was this determination to work methodically and untiringly over many years, within a self-imposed discipline, that distinguished David Thompson from his contemporaries.

For many of his revisions of the map of North America, Aaron Arrowsmith was greatly indebted to Thompson. During the years Thompson was employed by the Hudson's Bay Company his maps and reports were made available to English cartographers. Although Arrowsmith acknowledged his obligation to the company he gave no credit line to their brilliant young surveyor. The same conduct applied to information sent to Arrowsmith by the North West Company for geographical data obtained and compiled for them by Thompson.

Sir George Simpson in his Journal of 1824-25 stated: "The different establishments and points where observations have been taken are placed according to the latitudes and longitudes given us on Mr. David Thompson's chart and the relative situation in regard to distances where Observations have not been taken are given and regulated according to the length of time occupied in going from one place to another either by land or by water. This draft will be forwarded to the Honourable Committee, who may perhaps allow Arrowsmith to correct his map thereby, which in its present state is very erroneous".

On foot or by canoe Thompson covered more than 50,000 miles during his explorations and surveys. He was the first white man to travel the full length of that 'mystery river' of the Pacific Northwest, the Columbia. He built the first trading post on that great river in August, 1807, then known as Kootenai House. In midwinter, 1810-11, with ten companions he discovered and negotiated the Athabasca, now the Yellowhead Pass through the Rockies. This pass became a regular transportation route across the mountains and was adopted by one of the national railway systems as its main gateway route to the Pacific Ocean. Canada and the world owes to this distinguished man the first reasonably accurate map of the Canadian West, embodying results of his surveys from 1792 to 1812. He surveyed the Canada-United States boundary line from Maine to the Northwest Angle of the Lake of the Woods and prepared the appropriate maps. He was the first white man to canoe around the shoreline of Lake Superior for the purposes of survey and the first white man to fix the true source of the Mississippi and Missouri rivers.

In Montreal the death, on February 10, 1857, of David Thompson passed unnoticed by the press and public. His life had ended, as it had commenced, in poverty. His reputation in geographical matters might have been largely lost but for the laudable and zealous salvage work of J. B. Tyrrell of the Geological Survey of Canada. As an assistant to Dr. G. M. Dawson in geological surveys in the Canadian West Tyrrell was strongly attracted to the quality of Thompson's exploratory surveys and pioneer mapping. He was highly successful in rescuing Thompson's name and achievements from oblivion. As one of the editors of Thompson's journals, he assisted in bringing about their publication by the Champlain Society in 1916.

In British Columbia a major river bears Thompson's name as does a lake in the Rainy River district of Ontario. Historic plaques commemorating his deeds have been erected at various points across Canada, including Kootenai House on the Columbia, Williamstown, Montreal and in Jasper National Park. In Vancouver, students at the David Thompson secondary school obtained colored mosaic tiles from Italy and constructed an impressive mural in the school dedicated to "David Thompson, 1770-1857, Fur Trader, Map Maker, Explorer".[41] On May 23, 1927, a memorial service was held in Montreal's Mount Royal Cemetery. A monument was unveiled at Thompson's grave by Sir Frederick Williams-Taylor. "Without exact surveys and accurate maps", Sir Frederick stated, "it would have been impossible to open and allot our western plains for the homes of our present and future millions, or to develop that vast land with roads and railways. Remembering this, we begin to realize the heavy debt of gratitude our country owes to David Thompson. He worked not merely for his employers but for the increase of knowledge, not so much for his own time as for the future".

During the decade prior to Confederation two important exploratory and survey expeditions were despatched to Canada's Northwest. Both expeditions were government supported and instructed. The scientist-explorers who were carefully selected for these projects proved to be the advance guard of a small army of land surveyors, empowered to prepare millions of acres for occupation by property-hungry people from all over the world. The Palliser Expedition (1857-60) was financed by the British government; the Hind-Dawson Expeditions (1857-58) by the government of the Province of Canada. The reports of both investigations added immensely to knowledge of that portion of Canada west of the Great Lakes. Part of their purpose was to discover how much of the territory they examined was fit for cultivation. The comments that resulted served to stir considerable public interest in the settlement of the western interior.

Capt. John Palliser (1834-1907) was an energetic, wealthy, well-connected and observant Irishman with a strong bent for wilderness life and adventure. By persistence in his representations and with the help of some highly-placed supporters in London he prevailed upon the British government to organize and finance an expedition under his leadership to Western Canada. ". . . in addition to maintaining a regular series of instrumental observations, of regularly recording the physical features of the country . . . noting its . . . capability for agriculture . . . for practicable passes through the Rockies . . . and the quantity and quality of its timber and any indications of coal or other minerals".[42]

Four European experts were recruited to aid Palliser: Eugene Bourgeau, botany collector; Dr. James Hector, geologist-naturalist-medical man; John W. Sullivan, astronomical observer and Lieut. Thomas Blakiston, magnetic surveyor.

On arrival of some of the expedition members in New York Palliser discovered that one of his barometers had been broken in transit. The New York Observatory loaned one of its instruments to the party while their damaged one was being repaired. The itinerary of the expedition covered three main regions; Lake Superior to Red River; Red River to the Rockies; and thirdly, the Rockies area. The intention was to map all regions, to examine transportation routes, appraise settlement possibilities, make botanical, zoological, geological, meteorological and magnetic survey records. At one stage of their investigations the Palliser party linked up its westering explorations with the eastering international boundary survey by a British party under Col. Hawkins of the Royal Engineers. In October, 1859, the Palliser group encountered in the Rockies area Lieut. Henry Palmer, one of the ablest surveyor-explorers of the Royal Engineer detachment then in British Columbia.

Early in 1860 the Palliser group members were welcomed to the new mainland colony of British Columbia by Col. R. C. Moody, Capt. R. M. Parsons and other officers of the Corps of Royal Engineers. It required a considerable amount of time to prepare the report of the expedition. It was finally published in 1863 but the main map of the territory traversed was not published until 1865. John Arrowsmith started to draw a new map, checking Palliser's findings against all earlier information received on the regions. This procedure consumed so much time that the Colonial Office became impatient and turned over the mapping job to cartographer Edward Stanford.

Dr. James Hector (Sir James Hector in 1887), a most versatile member of the Pallister expedition, made geological observations, sketches and records that formed the foundation of later and more detailed surveys of the Canadian West. A small-scale map, 100 miles to an inch, summarized Hector's findings over three field seasons.[43] Some of his concepts, arising out of his Canadian investigations, proved both durable and influential. His use of the term 'fertile belt' stimulated, in itself, the interest of prospective settlers. His description of three main steppes of the western interior provided a theme basic to all future geographical writings on the region. But the finding that was to become most prominently and firmly associated with the Palliser report was that relating to the so-called Palliser Triangle. Hector stated: "The British portion of the arid country (extending north from the United States) is a triangular region, its apex reaching to the 52nd parallel while its base, applied along the 49th, extends between Longitude 100 degrees and 114 degrees West. It contains, however, many varieties of land, and some limited areas that are really even good; but, on the whole, it must be described as deficient in wood, water and grass".[44]

Sir John Palliser (he was knighted in 1877) did not return to Canada, dying in his home in Ireland in August of 1887. In addition to the famous Triangle, his name is perpetuated in Canada by such mountain features as a lake, river and pass, by a station on the Canadian Pacific Rockies and by the world renowned hostelry in Calgary.

In 1857 the government of the Province of Canada decided to send an expedition to examine the country between Lake Superior and the Red River in order to determine the best route over British territory between these two bodies of water and "to the great tracts of cultivable land beyond the Red River Settlements". The 1857 expedition was divided into three parties, one led by Professor Henry Youle Hind (1823-1908), chemist and geologist, University of Trinity College, Toronto; another by Simon James Dawson (1820-1902), engineer and surveyor; and the third by W. H. Napier, engineer. The Scottish-born Dawson had applied to the Canadian government in 1857 to explore the country between Lake Superior and the Saskatchewan River.[45]

Dawson was instructed to secure information on the topography and routes from Lake Superior to Red River. Hind was guided on his geological observations by a memorandum from Sir William Logan, first director of the Canadian Geological Survey. The expedition arrived at Fort William on July 31, 1857, and reached Fort Garry on the Red River on September 5. The Legislative Assembly of Canada decided to resume the investigation, directing that explorations be continued to the Saskatchewan River in the 1858 field season.

Professor Hind, for his part, reported that his explorations were made "with reference to the construction of a map as complete as possible of the region explored, on a scale of 2 miles to the inch". He mentions that the map of Selkirk Settlement . . . "is reduced from an authorized instrumental survey [made] by the Hudson's Bay Company surveyor, Mr. Taylor". Also that ". . . the data upon which [unvisited parts of the country] are laid down is derived from the large mss. map of the North West . . . by the late excellent but neglected geographer, David Thompson . . ."

"The labours of this remarkable man", states Hind in his report, are only now beginning to be appreciated. His map of the (International) Boundary Line between Lake Superior and Lake of the Woods is an admirable piece of work. We recognized every portage as we came to it . . . although Thompson's survey was made in 1826".

W. Fleming is listed in the official reports as assistant surveyor and draftsman of the expeditions and Lindsay Russell (later Surveyor General of Canada) as a chainman.[46] Another Fleming (later to become Sir Sandford) in this same year, 1857, came into prominence as chief engineer of the Ontario, Simcoe and Huron (later Northern) Railway, an early step up the ladder in a notable railway building career.

In his report published in 1859 in Toronto by John Lovell, Dawson indicated that the surveys extended over 4½ degrees of latitude and about 13 degrees of longitude. Detailed maps, on a scale of approximately 6 miles to the inch, accompanied these reports, including a general map of "a portion of British North America" showing what was believed to be the most easily accessible route through Canada and British Columbia, also sketches showing surveys made by L. A. Russell between Thunder Bay and Dog Lake. Dawson referred also to his 1858 Blue Book report and map of the 90 miles of country between Lake of the Woods and the Red River.

His report was one of the first to point out the possibilities of settlement on a substantial scale in the Canadian West. Like Hector, he interpreted the country westward from Red River as consisting of three main topographical divisions.[47] Dawson's report also marked the beginning of an auspicious career in surveying, construction work and public affairs.

Hind wrote what is considered by some experts to be the best geographical account of what is now Southern Manitoba as it appeared before the advent of railways. Some of his descriptions of the prairies border on the poetic: "The Red River Plain must be seen, too, by moonlight, when the summits of the low-green grass waves are topped with silver, and the stars in the west disappear suddenly as they touch the earth". Hind also observes prophetically, "It is a physical reality of the highest importance to the interests of British North America that this continuous belt (the western interior) can be settled and cultivated from a few miles west of the Lake of the Woods to the passes of the Rocky Mountains, and any line of communication, whether by waggon road or railroad, passing through it, will eventually enjoy the great advantage of being fed by an agricultural population from one extremity to the other".[48]

At about the time of the Mackenzie-Papineau troubles in Canada, an able, ambitious young artillery lieutenant began to study practical astronomy at Chatham, England. John Henry Lefroy (1817-1890), son of Reverend J. H. G. Lefroy, developed aptitudes along scientific lines that marked him as being well in advance of his times. Problems of terrestrial magnetism were engaging the attention of geographers the world over. In the spring of 1839 the British government decided to establish in various parts of the Empire, a series of magnetic stations. In 1840 Lieut. Lefroy was sent to St. Helena to take magnetic observations. He remained there until 1842 when he was transferred to Canada to set up an observatory. On the advice of Admiral Bayfield, then engaged in St. Lawrence Gulf surveys, the observatory site was chosen at Toronto. At this time plans were already formed to carry out magnetic surveys in the Lake Athabasca-Great Slave Lake region. The observer was to be Lieut. Lefroy.

On May 1, 1843 Lefroy set out on a momentous journey, accompanied by Bombardier William Henry of the Royal Artillery. Lefroy, in 1877, was knighted and Henry attained the rank of colonel before his retirement. In *canots de maître*, manned by voyageurs and Indians, numbering fifty in all, the party ascended the Ottawa River, sped across Lake Nipissing to Lake Huron by way of the French River, that well-travelled watercourse, which had echoed for so long to the dip of fur-traders' paddles. In a letter to a cousin, dated May 6, 1843, Lefroy vividly describes various aspects of the expedition; "Imagine a table rock", he writes from Chat Falls on the Ottawa, "shewing its grey face between patches of moss and grass, with young fir and juniper growing out of the crevices, three large birch bark canoes, the prettiest vessels that float, lie bottom upwards with keel to the wind, the open side to the fires, and under them and before are standing or lying some fifty voyageurs and Indians talking French patois, with more oaths than you would like to hear, and the light plays on the tents behind, and their red shirts and caps . . . in true Rembrandt effects". And again, "About an hour before daylight tents are struck, canoes loaded and off we start. Breakfast at seven or eight, tea boiled in a kettle expeditiously, dinner about one p.m. Camp about an hour before sunset. Canoes large, each carrying 14 paddles, 4 passengers and luggage.... Instruments suffer somewhat from rust. Am writing in a cramped position in the canoe, taking notes all subject to splashing".

Lieut. Lefroy makes some interesting comments on the mode of travel; "I think the circumstances of all the paddlers facing the direction in which they go, instead of turning the back to it, as in rowing, gives a peculiar effect of intentness, intelligent will, to the movement. Then they strike up old French songs, more particularly in approaching a fort, many of them very pretty [tunes], almost all curious. Their pronounciation is so extraordinary...". And again, a familiar note is struck, "From the Lake of the Woods to Winnipeg the musquitoes began to be very bad... one can neither eat nor sleep for them.... A large fly called the bulldog gives a more painful bite but it is followed by no irritation and they are stupid brutes, easily kept off. A bulldog draws blood by a fair bite instantly; a musquitoe is a considerable time boring before he gets blood, and a long time gorging himself. Have repeatedly seen them draw blood through my trousers which are thin cloth...". But there were moments of undiluted bliss also; ". . . the pleasure of lying down under a pure starry sky, a bright moon gleaming through the trees, and all around the wilderness of a forest of nature...".

On June 28 the party landed at Lower Fort Garry, to be greeted by Sir George Simpson, Governor of Rupert's Land. Then, by way of The Pas and Cumberland House, Lefroy and Henry crossed the Methy Portage to the Clearwater River, arriving at Fort Chipewyan on September 23. Already a frosty nip in the night air heralded the approach of winter. Writing at Lake Athabasca on December 13, 1843, Lefroy reports, "Arrived here September 23, cold weather already commenced... one-storied buildings with cheerless parchment windows. I found no building useful as an observatory. So necessary to build one, which we did in three weeks. I completed a set of instruments of the Absolute Intensity with six bars, and commenced a series of hourly observations on October 16. The observatory is kept habitable by a fire which ensures a more uniform temperature. It is only when there is much wind that we cannot keep it uniform, our parchment frames let in too much cold air.... We live on whitefish chiefly, varied with dried or fresh moose meat or buffalo. They grow potatoes here, and we have cows. Flour is the scarcest article and bread is unknown... a good many partridges about...".

On March 5, 1844, their instruments were repacked and transported by dog team to Fort Simpson, reached on March 26. Hourly observations were carried out there also. The party returned to Edmonton on August 19 and to Toronto on November 18. After reporting to army authorities at Montreal, Lefroy returned to Toronto on December 5 to take charge of the new Toronto observatory.

During the 18 months of his survey activities in the northern wilderness Lefroy travelled nearly 6,000 miles, setting up his instruments in scores of localities under most exacting physical conditions. Lefroy's measurements remained for many years the authority for the approximate position of the North Magnetic Pole. One of his tutors wrote of Lefroy's Canadian work, "it is probably the most remarkable contribution to our knowledge of magnetic disturbance we [thus far] possess". Not until 66 years later were the results of Lefroy's labors published in a book titled, *Diary of A Magnetic Survey of a Portion of the Dominion of Canada Chiefly in the North Western Territories Executed in the Years 1842-44*. It is interesting to recall that 13 years after the completion of these surveys Lieut.-Col. Lefroy, as he had become, recommended the appointment of Lieut. Thomas Blakiston of the Royal Artillery to the Palliser expedition as magnetic surveyor.[49]

In a letter to his mother from Montreal on April 25, 1843, Lefroy gives us a brief glimpse of some of the strains to which surveyors of those days as well as their instruments were often subjected: "The villainous state of the road between Kingston and Williamsburg literally shook to pieces a nine-inch Dip Circle by Gambey (a 27-pound instrument then used in magnetic surveys) and the loose parts were lying about in the box. But no damage was done, the most serious part was that one of the agates got jolted out of position and I had no level to adjust it again. I was obliged to do so by hand and test with the needle. Also parts of the theodolite were shaken out. The Barometers I carried on my shoulders, a little mercury had escaped from one of them but I hope not enough to impair its value".

In the early part of 1853, before he left Canada for England, Lefroy founded the Canadian Institute (now the Royal Canadian Institute) and became its first president. He ended his active military career in 1870 as Major-General J. H. Lefroy.

15

UPPER CANADA SURVEYS

"We first survey the plot, then draw the model;"
King Henry IV, (2), Act I, Sc. 3.

Major-General Sir Frederick Haldimand, named Governor General late in 1777, was quick to foresee that the services of a capable Surveyor General would be in lively demand in Canada during his vice-regal term. Accordingly His Excellency wrote to Major Samuel Holland, then attached to the army staff of Sir Henry Clinton at New York, requesting his return to Quebec. Haldimand was eager to obtain the man who was mainly responsible for the initial scientific large-scale land surveys in British North America and in New England. But the urgently-sought transfer was not completed until 1779.

During the first year or so following his return to Canada, Holland devoted much time to re-organizing the office and work-load of the Surveyor General. His duties, as time passed, proved to be varied, highly responsible and exceedingly onerous. In addition Holland served, as did Deputy Surveyor General John Collins, on the Executive Council of Quebec. In 1781 he surveyed Ordnance lands at Montreal and in 1782 he reported on the Township of Bulstrode.

Holland's resumption of duties as Surveyor General coincided with the beginning of a three-decade period of peace between Canada and the United States. It proved to be a period of considerable development and relative prosperity for both countries. The remote territory that was to become known, under the Constitutional Act of 1791, as Upper Canada, remained for the most part an unexplored wilderness, guarded by a few widely scattered military posts. But violent events in other parts of the continent determined the destiny of this upper country with inhabitants totalling, exclusive of Indians, some 2,000 people. The same eruptive events and the resulting exodus from the States of United Empire Loyalists, set the pattern for Holland's surveying plans and mapping activities for more than a score of years to come.

The year 1783 was one of heavy responsibilities and bright opportunities for Holland and his staff. The Treaty of Versailles formally ended hostilities in America. In England, Royal Society President Sir Joseph Banks invited Major-General William Roy of the Royal Engineers to make a survey from London to Dover. This move came as the result of the first proposal ever made for an international cooperative mapping venture. In October, 1783, the French Ambassador presented to Charles James Fox, one of His Majesty's Secretaries of State, a memoir written by the French Astronomer, Cassini. This document pointed out the advantages that would be derived from precise measurement of the distances between Greenwich and Paris observatories in terms of latitude and longitude. It was this same year that witnessed the largest influx into Canada of Loyalists seeking lands on which to settle. It was the year, also, that saw the founding of Parrtown, nucleus of the future city of Saint John.

Out of a deep consideration for colonists loyal to the British Crown who had been dispossessed of their American holdings, the British government decided to grant free lands for all Loyalists who might apply for them, as well as for disbanded soldiers willing to settle in British North America. Governor General Haldimand on August 7, 1783, received royal instructions that lands were to be granted to any commissioned officer-applicant, to be surveyed on a basis of 1,000-acre lots for field officers, with lesser acreages for captains and subalterns. These acreages were later considerably increased. To civilian Loyalists free patents were granted to a maximum of 200 acres each, upon subscribing to an oath of allegience and complying with certain minor regulations, including payment of nominal fees.

The Surveyor General was faced with an imposing tangle of distracting problems. It was the Shelburne conundrum again, but in different circumstances. Thousands of newcomers wanted to get located on new land without delay. As it was impossible to completely survey farm lots in advance of the settlers, how was the situation to be met? Without some clearing away of thick bush, surveyors could not establish required lines of sight. There was a complete absence of detailed maps of the new country and, in fact, it was not for another 15 years that a fairly accurate map of the kind was made available. Above all, there was an acute shortage of qualified surveyors. Holland solved the more immediate problem by ordering that initial surveys be confined to the laying out and posting of frontages or base lines of townships bordering rivers and lakes, then blocking out (on paper only) townships to be constructed on the frontages so drawn. This blocking-out process included indications of concessions or ranges, as well as lots and road allowances. The properties were then distributed by ballot to the settlers. In brief, then, the plan involved the laying out of waterfront parcels for immediate occupation and then working inland with surveys as the need arose. The township was closed off by the surveyors when it was considered large enough.[1]

On May 26, 1783, Haldimand sent a letter of instructions to Holland, conveying what is probably the first order concerning a British survey to be made in what is now the province of Ontario.[2]

"You are directed", stated Haldimand, "to set off immediately for Montreal and proceed to Cataraqui [Kingston] where you will minutely examine into the situation . . .". Holland was also instructed to send his assistants from there to the Niagara country on a similar errand. The Surveyor General arrived at his Cataraqui destination late at night on June 10. His report to Haldimand of June 26 indicated that among the developments of June 11 was a survey of the harbor made by his assistant with "Captain LaForce to take the soundings". He added that "Lieut. [William] Tinling [has] joined me . . ." and mentioned that Captain LaForce, with Lieutenants [Louis] Kotté or Cotté and

[James] Peachey, proceeded later to conduct an exploratory survey along the north shore of Lake Ontario all the way to Niagara.[3]

Encouraged by the information provided to him by these preliminary surveys Haldimand set the official stage for launching the pioneer land surveys of the upper country.[4] In a message dated September 7, 1783, conveyed by John Collins to Major Ross, commander of Fort Oswego, the Governor General advised that ". . . Mr. Collins . . . with proper assistance I have sent to Cataraqui in order to survey and mark out the settlement at that place for the refugee Loyalists". His Excellency added, "I enclose for your information a copy of my instructions to Mr. Collins, by which you will perceive that it is my intention to have the lands distributed in townships containing lots of 120 acres . . . Captain LaForce, Captain [Justus] Sherwood[5] and others skilled . . . in principles of colonization accompany Mr. Collins".

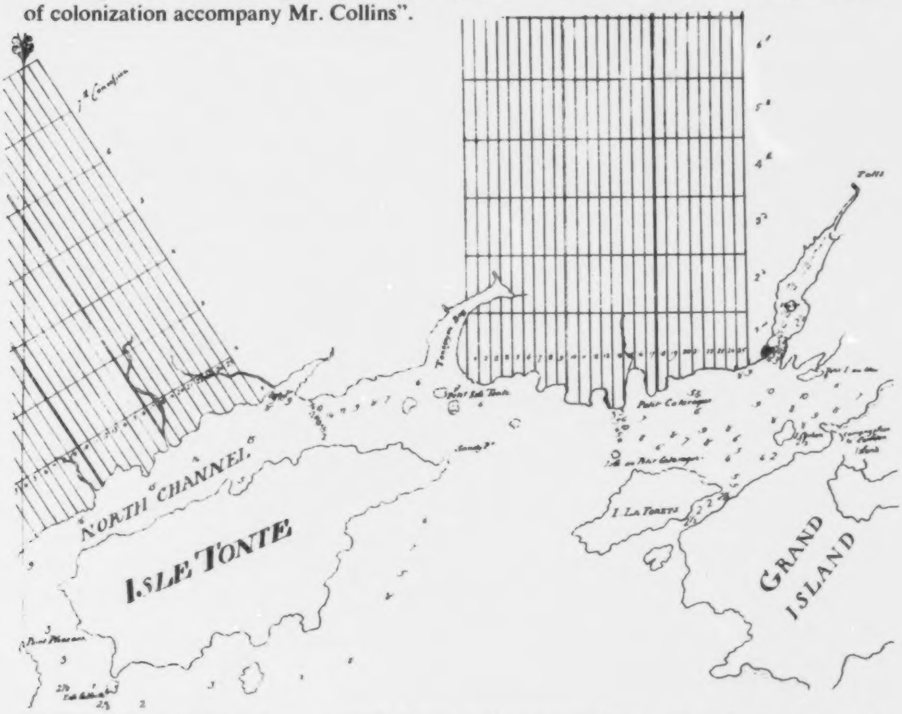


FIGURE 24. No. 1 Township, Cataraqui, 1784. Part of a plan of the north side of Lake Ontario as surveyed by Deputy Surveyors Kotté and Peachey under the direction of Surveyor General Samuel Holland.

Haldimand's basic concept of a scheme of settlement and plan of survey for Upper Canada was undoubtedly influenced by the Royal Instructions of 1763 addressed to Governor General Murray, especially paragraphs 45 and 46 dealing with townships. Very likely he had in mind also the fact that the Loyalists from New York and New England had become accustomed to town government related to a rural area of 30 or 40 square miles, tributary to a relatively small urban nucleus. Thus wrote Haldimand, "The Method of laying out Townships of Six Miles Square I consider as the best to be followed as the People to be settled there are most used to it, and will best answer the Proportion of

Land I propose to grant to each family . . .". Thus the township became the unit of settlement along the Upper St. Lawrence River, just as the seigniory had been the unit of settlement in French Canada.

The initial pattern of survey in what is now Ontario came to be known as the *single-front system* and was in vogue from 1783 to 1818. A single-front township was one, as we have seen, in which it was customary to survey the township boundaries and the fronts of concessions and to establish lot corners on such front lines. The size of the lots and townships varied somewhat and no absolute standard seems to have been followed. In addition there were a few townships surveyed in a manner incapable of any regular classification. Sandwich township on the Detroit River, for example, was laid out to accommodate French settlers.

Because of its key significance in the story of Canadian surveying, the text of the letter of instructions dated September 11, 1783, sent by Haldimand to Collins is reproduced here in its entirety:

"Headquarters, Quebec,
11th September, 1783.

John Collins, Esq.:

Sir: It being my intention to establish settlements for the provision of part of the distressed Loyalists resorting to this Province at and in the neighborhood of Cataraqui, upon Lake Ontario, you are hereby directed to proceed to that place without loss of time for the purpose of surveying and laying out the several lands in townships and lots agreeably to the following instructions:

1. You will make an exact survey of the neck intended for the town plot, describing and expressing the nature of the ground and soil, and if Point Frederick is not commanded from Point Henry, on both which places sufficient spaces for fortifications must be reserved.

2. At the west side of Cataraqui Harbour the ground near the fort and within the lines (as marked in the plan A, B, C) must remain to the Crown, for the use of the garrison, and as a place of resort for the Indians, where some of the most noted might be allowed to build, reserving sufficient spaces round the slips (where vessels were formerly constructed) unincumbered with buildings.

3. Though a common, containing about 400 acres, must be reserved for the use of the town, leases may be given for a term of years, not exceeding 30 years, to settle there as the people for the present will be glad to be as near the town as possible, and the common will be cleared by the time the town will be in want of it.

4. The method of laying out townships of six miles square I consider as the best to be followed, as the people to be settled there are most used to it, and will best answer the proportion of lands I propose to grant to each family, viz: 120 acres, of which six are to be in front, which will make 19 chains in front and 63 chains 25 links in depth, so that every township will have 25 lots in front and 4 chains 75 links will remain for roads, with 7 concessions in depth. Fifty-eight links will remain for a road, by which distribution each township will contain 175 lots of 120 acres.

For your assistance in the execution of this business you will be joined at Montreal by Captain Sherwood and Lieut. Cotté and also by Mr. Grass, captain of one of the companies of militia intended for that settlement, and these gentlemen will be attended by axemen, etc. proper for that occasion.

You will begin your survey by a township on each side of the bay, and transmit it to me, together with your remarks, reporting to me in the like manner from time to time the progress you shall make.

As it is not improbable that in exploring these lands some of the persons employed may make choice of particular situations, and make preparations accordingly, to prevent which you are to signify to them that my intentions are to distribute the lots impartially by drawing for them, and that all timber cut down this fall, or any log houses they may choose to make and reside in until the settlements shall be regularly granted, will not be considered as any right of such persons, but entered as a temporary beginning, and should any of them prefer remaining there this winter to returning to Sorel, may have lots of four acres marked out for them in common, which they will enjoy for 30 years, as before mentioned, by which means whatever work is done will forward the clearing of the common and be for the public good. The officers commanding at Carleton Island, Cataraqui, or any post you shall have occasion to call at, are hereby directed to afford you every assistance in their power, whether in provisions or otherwise, for the speedy and effectual execution of these instructions.

Wishing you success, etc.
(Sd.) F. Haldimand."[6]

Collins arrived at Cataraqui on October 1, 1783, after experiencing "excessive bad weather" almost every day since leaving Quebec. Major Ross advised Collins to postpone activities until the lands for the proposed new townships were "purchased from the savages". Collins filled in the intervening period by surveying properties fronting on the lake. It was later in the month of October that the historic Crawford Purchase was negotiated. William Redford Crawford of the Royal Regiment of New York, acting for the Crown, purchased for settlement purposes from the Mississauga Indians at Carleton Island land that now comprises the counties of Frontenac, Prince Edward, Lennox and Addington, Hastings, Glengarry, Stormont, Dundas, and Leeds.

Adverse weather resulted in a water-logged Cataraqui countryside and by early November Collins and his men had completed the outline survey of only one township, the plan of which he forwarded to Haldimand at once along with a plan of Point Henry by Lieut. Kotté[7]. Sherwood and Collins began work on November 4 on the second township, located a few miles from the first. The land between was stony and unfit for cultivation. Collins declined to lay out any township on the east side of the Cataraqui River, but Lieut. John F. Holland laid out a townsite, as distinct from a township, on the west side of the river. This surveyor was the eldest son of Samuel Holland and had studied surveying under his father, who often named him in his reports. John Frederick Holland was Acting Engineer at Cataraqui in 1783-84. Later on Collins mentioned to Haldimand that he had employed "Mr. Tuffe and Mr. Henry Holland with each a good party when drawing the lines of the 2nd and 3rd concessions of the first township".

In all, Deputy Surveyor General Collins and his aides surveyed four townships before the end of 1783. At first the early townships were known by number bestowed as surveys of each, in turn, were completed. Later these first four townships came to have the names, respectively, of Kingston, Ernestown, Fredericksburg and Adolphustown, following the practice then adopted of christening early townships after the sons and daughters of King George III. On August 12, 1784, Collins reported that he had completed the survey of Township No. 5 (Marysburgh).

Collins had been clothed with authority to administer oaths and he reported that in regard to Marysburgh all British and German disbanded troops had drawn their lots, each man had taken the oath of allegiance, signed the books, received his certificate of title and settled on his land. Concerning the townships laid out during the previous autumn Collins commented: "The poor people have set themselves down . . . in different parts of the townships, not knowing where to find their lots, except those on the front; nor can it be expected [otherwise] until the several lines between the different concessions be drawn and boundaries fixed. . . . I should have set out on that business this day, but find myself too weak, having just got quit of a fever. . . ."

In the late summer of 1784 the Surveyor General made a trip to Cataraqui and in a letter (August 21) to his friend General Tryon, Samuel Holland refers to the fatigue of himself and his deputies in surveying "where insects are in such multitudes". He mentions that Lieut. Henry Holland, his second son, had been helping Collins with surveys on the Bay of Quinte. Henry was apparently with the 70th Foot Regiment at the time, on loan for survey work on a half-pay basis. Henry was drowned at sea in 1798.

In the main the distribution and settlement of land proceeded satisfactorily. One officer of the Royal New Yorkers, Capt. James McDonell, became disgruntled over the lot assigned to him and insulted Samuel Holland. Haldimand, who heard of the incident, promptly ordered McDonell to be sent down the river and to forfeit his lot. McDonell, his anger cooled, apologized to Holland and was reinstated.

Settlers continued to stream into the upper country and by July, 1784, at least 187 settlers were on the land in Kingston township. There is some uncertainty over the time of the first application of "Kingston" to Cataraqui but Collins in 1788 definitely assigned the name "Kingston" to the new townsite. Collins on May 15, 1788, submitted his account for expenses for surveys in the area and drew up an outline of survey work yet to be completed in the general area.[8]

Holland and Collins, on the whole, worked in harmony but did not always see eye to eye. For instance, a dispute arose over Township No. 4 (Adolphustown). Collins had informed Haldimand he would not survey it until he had discovered to whom the land belonged. Holland and Collins took opposite views on this method of procedure and finally the question was referred to Haldimand for determination. The outcome was that the township was divided and the east strip was attached to Township No. 3 and became known as Fredericksburgh Additional.

The first Canadian ordinance bearing upon survey activities other than those in French Canada was proclaimed in 1785 (25 George III, ch. 3). In brief this statute provided for the establishment of a meridian in the presence of the Surveyor General or of his Deputy; the testing of survey instruments before use; examinations of a surveyor before his appointment as such; the obligation of a qualifying surveyor to take the oath of allegiance; the provision that surveys made prior to 1780 be not disturbed; all surveyors to keep field notes and upon the death of any surveyor, his notes to be filed in court and made available to the public. By a second edict later that year, surveyors were debarred from acting as notaries and notaries as surveyors. The 1785 law constituted, in effect, a legal foundation upon which the edifice of all following Canadian enactments on surveying was built.

As the science of surveying and registration of land titles are, in practice, such closely interwoven activities, it should be noted that the first Land Registry Act, applicable to what is now Ontario, was passed in 1795.* It provided for the registration of documents of title, not original deeds, by means of alphabetical indices, based on the names of property owners. The effectiveness of this system depended upon adequate maintenance of records. But such careful maintenance could not be relied upon consistently. In 1865 the registry system in Upper Canada was altered by the introduction of the "abstract index" under which information on the owner's name was not essential to a search of title.

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*First Parliament, Upper Canada, 35 George III, ch. 5. August 10, 1795.

In the spring of 1784, at a time when David Thompson was entering his period of apprenticeship with the Hudson's Bay Company, Loyalists and disbanded troops were leaving their winter quarters at Sorel to set off up the St. Lawrence in boats. By midsummer more than 4,000 had settled in two groups; the first in 8 townships westwards from New Longueuil Seigniory; the second in 5 townships from Cataraqui to the Bay of Quinte. The greater part of Capt. Michael Grass' party settled in Kingston Township. At this time there were about 46 families at or near Niagara and about 700 acres were cleared there. Still farther west, opposite Detroit, there was an undetermined number of settlers. These localities in the west increased in population until by 1787 what is now southern Ontario contained more than 17,000 people. Land made available for settlement through purchases from Indians had extended, by 1792, along the entire northern shore of Lake Ontario, the Niagara Peninsula and most of what is now eastern Ontario. The loyalist Six Nations of Iroquois had accepted, by 1785, in compensation for territories in northern New York State lost to them, a tract of land drained by the Grand River. Theoretically this land could not be alienated by them but in practice several large blocks were sold by Indians to incoming settlers and land promoters.

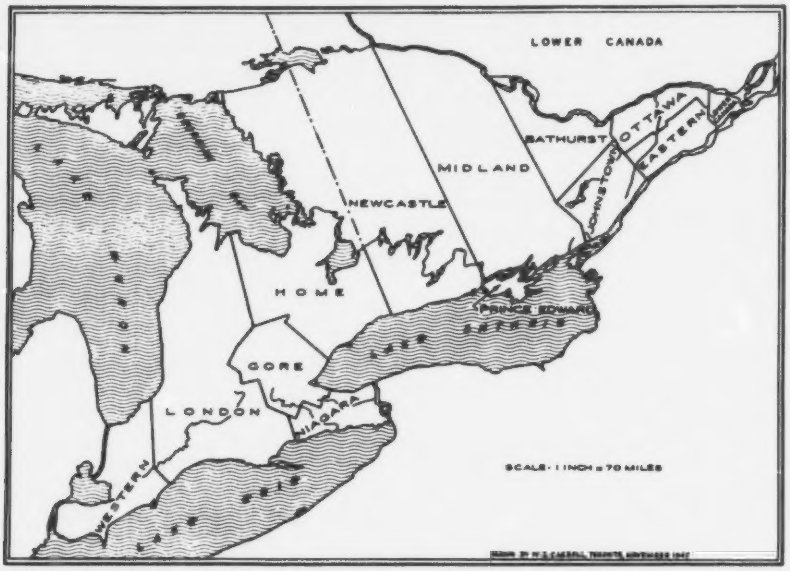

FIGURE 25. Map of Upper Canada showing Districts, 1836.

The population in what is now eastern Ontario was divided among four original settlement areas or districts named Luneburg, Mecklenburg, Nassau and Hesse, after branches of the Hanoverian dynasty. Deputy surveyors, appointed by the Surveyor General, were attached to each district. Nine townships were formed in the Luneburg District, twelve in Mecklenburg.[9] Townships in the two western districts seem to have been known only by their numbers. The names of these four original districts were changed in 1792 to Eastern, Midland, Home and Western district respectively.*

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*The renaming was accomplished by an Act (32 George III, ch. 8) passed at the opening session of the first parliament of Upper Canada in 1792.

In order to expedite the entire settlement process, land boards were established early in 1789 in each district. These boards directed surveyors as to what surveys ought to be performed, though not on detailed methods to be followed. The boards were also empowered to receive applications from settlers for land. When granted the board issued a certificate to the petitioner addressed to the Surveyor General, requesting assignment within two days to the certificate holder of a single lot of 200 acres, improvements on same land to be made within one year. These boards served their emergency purpose and on November 6, 1794, were abolished. From that time on, surveys were made under the direct instructions from the Surveyor General or from his Deputy.

In a report to Lord Dorchester, dated December 19, 1787, Collins stated: ". . . I conferred with Sir John Johnson respecting boundarys to be fixed between the Mohawk Settlement and that of the loyalists and called twice on Captain John [Indian] chief of that Village, to inform him of the mode of Settlements we have agreed upon, *he being absent I acquainted his wife* and accordingly proceeded to fix the boundarys leaving a tract of 12 miles fronting on the Bay of Quinty by 15 miles in depth. . . . This extensive tract it appears is by no means satisfactory to Captain John who I am informed from good authority *he spoke in very threatening terms* . . . I have amicably settled all disputes occasioned by erroneous surveys made in several parts of the lower settlements which in short time would have been the ruin of many worthy familys . . .". (author's italics) In the end the Indian tract matter was also settled to the satisfaction of those directly concerned. In connection with these 1787 surveys Collins mentions the names of surveyors Kotté, Aitkin, McDonell, Chewitt and McCarthy.

In 1787, the year that the Corps of Engineers of the British Army became the Royal Engineers, a new survey system appeared in the Niagara Peninsula. Actually this system was confined to 13 townships in that area. Surveyor Allan McDonell is credited by some with the authorship of the new mode that had the surveyor running all the side lines, travelling back and forth in the manner of a shuttle, from front to rear of a township. This method, known as the *front-and-rear system*, involved an impressive total mileage in survey lines and was not calculated to win favor among authorities lacking ample public funds. This system did not spread to other parts of the upper country and was discontinued in the Niagara Peninsula in 1813.

Meanwhile Collins and his assistants had been fully occupied along the Upper St. Lawrence River area. In June, 1785, Collins had reported to the Governor transmitting a plan of the Second Township of Cornwall "which is the only one below Cataraqui that has been regularly surveyed, all the others having nothing more than the front line run with a single picket set up at each side of the lot. . . ." On June 18 Collins instructed Patrick McNiff to run front lines of the 2nd, 3rd and 4th concessions in the townships of Lancaster, Osnabruck, Williamsburg and Matilda, leaving an allowance of forty feet for the width of a proposed road between each concession and setting up posts carefully "to serve as a government to the inhabitants to divide their lands". By the end of 1785 McNiff reported that all people were on their lands in the five lower townships. He recommended that all applicants for land help pay the expense of required surveys by finding chainmen or axemen and that the whole of the township population assist in cutting roads. In February, 1792, McNiff's recommendation concerning the distribution of the cost of the surveys was officially adopted.

In 1791 the Constitutional Act was passed and the old, extensive province of Quebec was divided into Upper and Lower Canada. Col. John Graves Simcoe (1752-1806), son of the captain of the *Pembroke* at Louisbourg, was appointed Lieutenant Governor of Upper Canada. Following his arrival in the New World in 1771 this youthful one-time ensign of the 35th Regiment of the Line, had risen to command the Queen's Rangers. By 1791 he was a member of parliament at Westminster for Cornwall riding. Simcoe arrived with his wife and two children at Quebec in November, 1791, and wintered there. He had numerous opportunities there to develop close relationships with Samuel Holland who, 34 years previously, had come to know his father at Louisbourg. Simcoe could not fail to notice, however, the deterioration in Holland's bodily health. "Poor Holland," he wrote to a friend privately, "that good and faithful servant of the Crown is worn out in body, though in full possession of his intellect. His deputy Collins [now] possesses neither strength nor intellect".[10]

Before leaving Quebec Simcoe asked Surveyor General Holland to provide him with names of the duly qualified deputy surveyors then available in Upper Canada. The list, when furnished, contained the names of William Chewitt, Patrick McNiff, Alexander Aitkin, William Fortune, Hugh McDonell, Theod. DePencier, John Stegman, Joseph Bouchette and Augustus Jones. But there are curious omissions. The list makes no mention, for instance, of Philip R. Frey, prominent in the surveys of the Niagara district, nor of James McDonell nor of Kotté. By letter from the office of the Surveyor General, Quebec, dated July 20, 1790, the land board of Nassau District had been directed to employ Philip Frey (appointed a deputy surveyor by Holland on January 19, 1785) as surveyor in charge of a party of ten men for the marking out of front lines of the townships from the eastern boundary of Nassau to what is now Toronto, and to "carry the sidelines of each township one mile well-marked."

The Constitutional Act provided that *lands equal in value to the Seventh part* of grants made since the beginning of British rule and, subsequently, of all future grants,

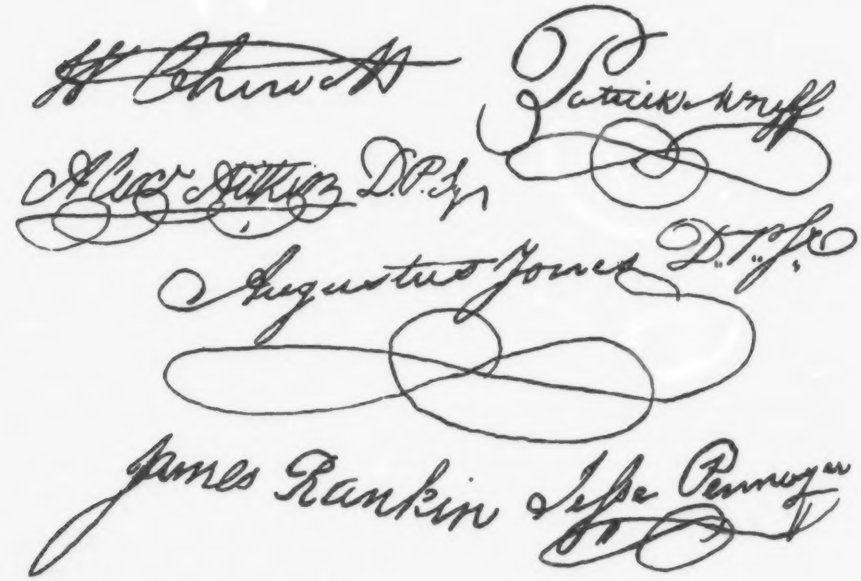

W Chewitt
Patrick McNiff
Alexr Aitkin D.P.Sr
Augustus Jones D.P.S.
James Rankin
Jesse Pennoyer

FIGURE 26. Signatures of some early Upper Canada surveyors.

should be reserved in both Upper and Lower Canada for the use of the Protestant clergy. These came to be known as Clergy Reserves. These were sold or otherwise secularized by 1854. On Colonial Office instructions another seventh was reserved for the Crown. The sketch on page 273 shows how townships were surveyed in order to provide for these Clergy and Crown Reserves.

Man-made conditions under which surveyors worked in those early times in the upper country appear, to modern eyes, unduly harsh. In order to place Deputy Surveyors of Upper Canada on the same rates of pay as those in Lower Canada, Simcoe in 1792 ruled that one-quarter of a dollar a day be allowed "to find your own ration". For a 'coasting survey' any number of men could be employed, not exceeding 10; for an 'inland survey' not more than 12. The allowance for axemen was 1/6 of a [Halifax] shilling a day and for chainbearers, 2½ [Halifax] shillings a day. For the daily quarter-dollar allotment the Deputy Surveyor was obliged to deliver to each person employed on his party, 1½ pounds of flour, 12 ounces of pork and ½ pint of pease [peas]. "If you are furnished with a Battoe, axes, tomahawks, camp kettles, oilcloths, Tents, Bags for the King's Stores, you will be allowed only 10 pence rations for your party".[11]

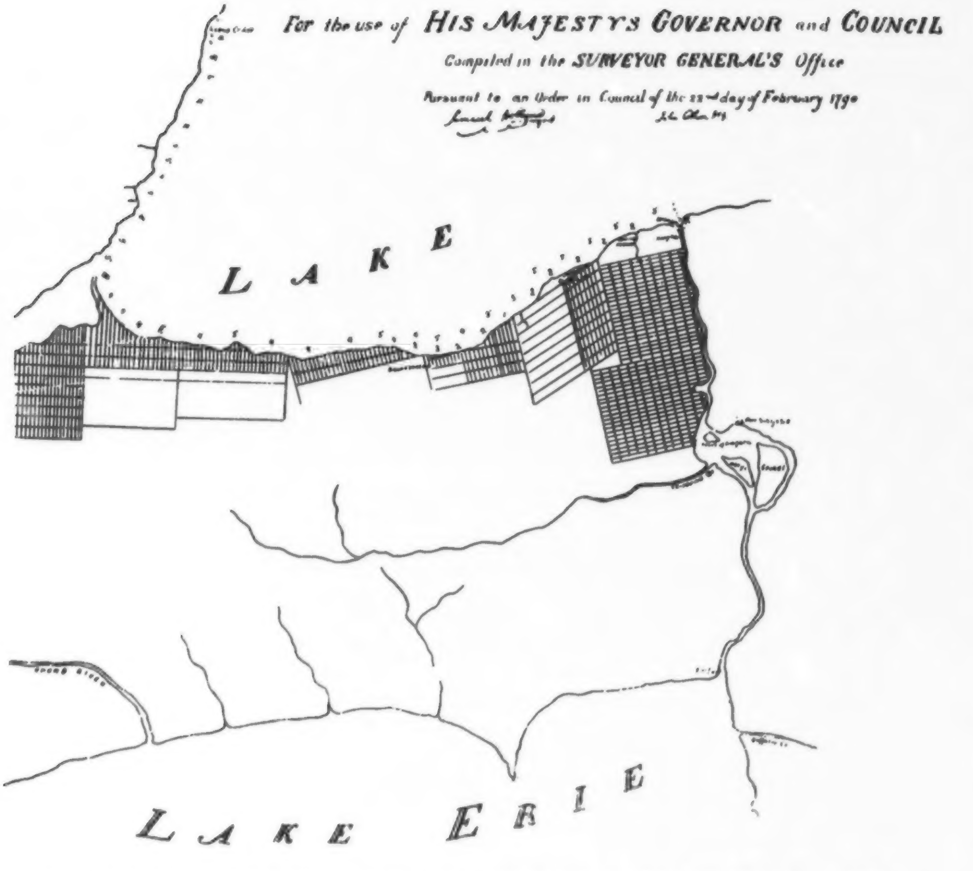
In these same instructions it was provided by paragraph 18 that the party chief ". . . will in general protract all your surveys on a scale of 20 chains to an inch, and you will transmit to the Surveyor General's office, with every survey . . . a written report explanatory of your survey with a copy of your field notes. . .".

With the setting apart of Upper Canada as a separate province, Major Holland's official connection with that part of Canada virtually ceased. He continued, however, as Surveyor General of Lower Canada. In any event it is improbable that he visited any western point after 1784. On June 21, 1792, Simcoe wrote to Henry Dundas, the first Viscount Melville, Secretary of State (in the British Cabinet) for War and the Colonies. ". . . [the office] of Surveyor General requires great Professional abilities and equal integrity. It was on the conviction of the important Qualities necessary for this office that I did not venture to recommend to you any of the numerous persons who applied to me . . . for this Employment and I greatly fear through the incompetence of persons who Major Holland, that able servant of the Crown, has been formerly obliged to employ in Upper Canada, I shall have considerable difficulty, if I may judge from the documents before me, in the preventing of the most mischievous litigations".

In the light of this communication it is mystifying to find that the following month David William Smith, captain of the garrison regiment at Niagara, untrained (as far as is known) in land surveying, was named Acting Surveyor General of Upper Canada. This appointment is even more puzzling in as much as William Chewitt had both the desire and technical qualifications for the position. On Simcoe's arrival in Quebec, Holland had recommended Chewitt to him as one eminently suited to take charge of land surveys in the upper country. At the time Chewitt had understood that the recommendation had been accepted but on attending a Governor's levee at Niagara months later, Simcoe told him that he had appointed Smith as Acting Surveyor General but that he would name Chewitt, Deputy Surveyor General. Smith, an upright, painstaking official who was universally respected, did not receive his commission until May, 1800. This rejection of Chewitt, for reasons never made known, was not the only reverse experienced by Chewitt in his hopes for advancement.

Despite failing health Holland made a gallant offer of his personal services to Simcoe in a letter from Quebec, dated October 4, 1792:

"Sir: A retrospect of the surveys . . . made . . . point out their being altogether local and confined to a small tract of that valuable country now under your Excellency's gov-



For the use of HIS MAJESTY'S GOVERNOR and COUNCIL
Compiled in the SURVEYOR GENERAL'S Office
Pursuant to an Order in Council of the 22nd day of February 1790
LAKE
LAKE ERIE

FIGURE 27. Plan of the District of Nassau, Section One, signed by Samuel Holland and John Collins c. 1790.

ernment . . . [and are] still far from being accurately delineated on any plan or map . . . owing to want of a general survey being made and latitudes and longitude taken to ascertain the true position of the most principal places situated on the several Upper Lakes . . . I am ready with a tried and approved set of astronomical instruments to take an active part in the operation myself . . .". Holland proceeded to point out the need to determine the true length of Lake Superior and to ascertain more accurately the distance from its most westerly extension to Capt. Cook's "line of coast, discovered in the Western Ocean". There is no record of any official acceptance of Holland's bid to perform these formidable tasks "with every possible care, exactitude and dispatch".

Following the death of John Collins in 1795, Holland failed more rapidly. The toll of sustained physical and mental exertions over so many years began to show. On December 28, 1801, at the age of 73, he died at Holland House with his wife Marie and family gathered at his bedside. An issue of the *Quebec Gazette* early in January, 1802, described the final ceremonial salutes to this great Canadian. "On Saturday last was interred the remains of the late Major Samuel Holland, Surveyor General, with military honours due his rank and length of service . . . His remains . . . were escorted by a detachment of troops (200 men) and a Band commanded by Major de Salaberry, accompanied by the most reputable Gentlemen of the City, Civil and Military, thence to the [family] cemetery in the suburbs, where three volleys were fired by the troops". Burial was in the plot at Holland Farm under the famous Holland Tree, beside the remains of Samuel Junior.

The tragic death of Samuel Lester Holland, his fourth son, at the age of 19, shadowed the father's declining years. As a result of a bitter feud between the lad (a lieutenant in his father's old unit, the 60th Regiment) and Capt. Shoedde, a duel was arranged at Point St. Charles, then on the outskirts of Montreal. Hearing of the insulting behavior of Capt. Shoedde towards the Holland family, the father sent Samuel a brace of engraved duelling pistols which he claimed had been given to him by a famous commander. "Sam-

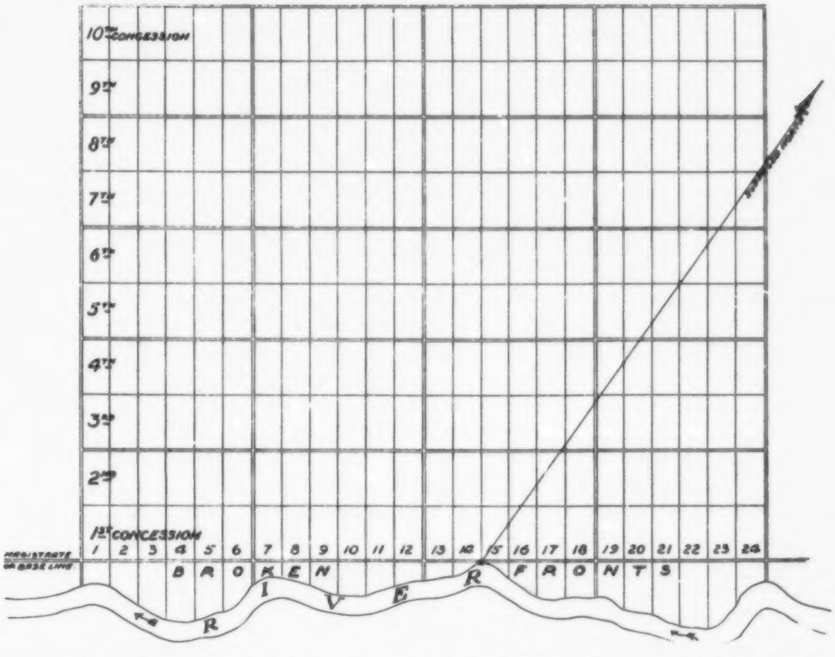

10th CONCESSION
9th
8th
7th
6th
5th
4th
3rd
2nd
1st CONCESSION
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
BROKEN FRONTS
RIVER

FIGURE 28. Specimen sketch for guidance of surveyors as supplied from office of the Acting Surveyor General D. W. Smith c. 1792.

uel, my boy", wrote the Surveyor General, "here are the weapons which my beloved friend, General Wolfe, presented to me on the day of his death. Use them to keep the old family without stain".* Vindication was not to come, however. Samuel Junior fell mortally wounded. His death was a grievous shock to the whole Holland family.

Holland's actions and correspondence reveal him as ambitious, tactful, industrious and highly competent. Always respectful to his superiors in rank, he was ever alert to opportunities for advancement. Holland reached a post of key importance in a rapidly changing New World. In spite of unexcelled speculative opportunities for making easy money, there is no evidence that Holland became wealthy. In days before journeys by train, motor car or plane and when watercourses offered the best highways of communication, Holland's travel mileage during his active surveying career reached an astonishing total. He was chiefly responsible for many of the pioneer land surveys in Lower Canada, Upper Canada, the St. Lawrence Gulf Islands, Prince Edward Island, parts of New Brunswick and of Nova Scotia (Cape Breton) as well as of New England and of lands even farther south. His surveys extended over more than three decades, including the most important formative surveys during the nation's transition from French to British administration.

The name of Canada's first Surveyor General is remembered today in such continuing place names as Holland Avenue and Holland School in Quebec City, by a cove in Prince Edward Island, by Holland Landing near Lake Simcoe and by a river, draining appropriately enough into Cook Bay in that same lake. These names serve to remind Canadians of a notable, constructive career without parallel in the annals of our earliest scientific surveying and mapping in Canada.

In June, 1787, Deputy Surveyor Philip R. Frey commenced a systematic laying out of the Stamford settlement, the second township to be surveyed in the Nassau District. Frey undertook this project on orders from Major Campbell, the commandant at Fort Niagara. As he marked out each holding, Frey gave the owner a ticket bearing the lot number on Frey's governing plan. Frey warned all property holders not to regard these tickets as in any sense title-deeds to the land to which they referred. Scarcity of paper in the settlement posed a problem in the production of the required number of tickets. So Frey began to use playing cards as land tickets. As the backs of the cards were commonly blank, Frey would write a few words on them and add his signature. There is no indication that jokers were used. But as there were no vaults or safety deposit boxes in which to retain the precious tickets or cards, a fair number of them were lost or destroyed by mildew, fire or mice. This situation produced much anxiety among settlers and numerous property boundary problems in later years.

Frey found that previous surveying work had been poorly done in the district. The new lines that he laid down resulted in considerable consternation in some cases. Settlers found that under the new allotments buildings they had erected were on other men's properties and, in some instances, months had been occupied in back-breaking toil clearing land they had no right to occupy. In September, 1787, Frey forwarded to the Surveyor General at Quebec survey plans of townships No. 1 and 2 "the first concessions of the latter lately surveyed". Records show that Augustus and Ebenezer Jones were with survey parties working in that township (Stamford) during November and December, 1787. Augustus at the time was a chainbearer for Frey.

Two of the Deputy Surveyors included in the Holland list to Simcoe worked together for several seasons. Augustus Jones (1763-1836) and John Stegman (1754-1804) singly, as well as in cooperation, completed a remarkable volume of township and road surveys. Stegman, a former lieutenant in a German regiment that had fought on the British side during the American Revolutionary War, settled in Canada and was appointed a Deputy (Provincial) Surveyor on October 18, 1790. He was in active practice in Upper Canada at a time when Capt. Vancouver was engaged in his historic marine surveys along Canada's western seaboard.

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*The duelling pistols are now in the possession of the McCord Museum, Montreal. These are inscribed "The Gift of Major General James Wolfe to Capt. Sam'l. Holland, 1759."

Jones and Stegman, working out of York in the years 1796 to 1798, surveyed the townships of Wolford, Burford, Oxford and Blenheim. In 1800 Stegman laid out the 2nd, 3rd and 4th concessions on the east side of Yonge Street and in 1801 was directed to report to Surveyor General Smith on the condition of that highway. Stegman wrote on June 10, "I have the Honour to report . . . that the most ancient inhabitants of Yonge Street have been most neglectful . . . and I have reason to believe that some trifle with the requisition of the Government in respect of clearing the street". In that same year Stegman examined Markham township and in 1802 wrote to the Surveyor General, "I beg you will have the goodness to send me a bush sextant". While on a surveying assignment two years later, travelling on a government schooner, Stegman was drowned.

Augustus Jones, a settler of Welsh descent, came to Canada as a refugee Loyalist. He obtained a grant of 300 acres in Saltfleet township near Stoney Creek. Jones, as we have noted, began his surveying career as an assistant to Philip Frey, working along the Niagara Frontier. In 1788 Jones was appointed a Deputy Surveyor to the officer commanding the upper posts. He quickly won the confidence of Simcoe and received numerous surveying assignments from the energetic and constructively-minded governor.

From 1787 to 1799 no other surveyor in Upper Canada measured out and subdivided so large or so important an area as did Jones. In the year of his appointment he surveyed Thorold, Pelham, Saltfleet and parts of Clinton, Grimsby and Bertie townships. Collins, in his first official message to Jones, requested maps of the townships he had surveyed, with the names of settlers marked on lots, all on the scale of 40 chains to an inch. Swamps were to be shaded in on the plans and the courses of small creeks shown. Road allowances as surveyed were to be indicated also although in many instances settlers carved out their own rough trails long before surveyors arrived on the scene.[12]

The Jones' surveys were not completely faultless. Hon. Peter Russell, President of the Executive Council and Administrator of Upper Canada (1796-99), was a prominent administrator in matters of land development and related surveys. During his term of office he was on record with one pointed complaint on the quality of surveying work. As one who was responsible for much of the planning of the new town of York, Russell wrote feelingly to Surveyor General Smith:

"It is much to be lamented that Mr. Aitkin and Mr. Jones have not been more accurate in laying off the Blocks. But as the Evil is Committed, all we have to do is remedy it the best way we can . . . notice [should be] given that no person in future shall presume to lay down a house, until the Surveyor examines the Spot and declares it to be agreeable to the Regulations of Council".[13] Here we have another sign foreshadowing the advent of modern town planning in Canada.

Jones surveyed Dundas Street, the "Governor's Road", from Burlington Bay to the Thames in 1792-94 and explored the sources of the Thames River. With Stegman he surveyed Yonge Street from Lake Ontario to Holland Landing, 1794 to 1797.* In 1798 Jones surveyed the town of York. The following year marked the end of his active survey work and he enjoyed a rather lengthy period of retirement. He died at Cold Springs on November 16, 1836. Surveyor of Iroquois lands along the Grand River,

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*Yonge Street survey commenced January 26, 1794. Four men of the Queen's Rangers served as chainmen and axemen.

LIEUT-COL MAHLON BURWELL
1783 1846

FIGURE 29. Plaque honoring Surveyor Mahlon Burwell, erected at Port Burwell, Ontario, in 1960 by the Ontario Archaeological and Historic Sites Board.

Jones was always on good terms with Indians of the province. In 1798, in fact, he married the daughter of an Indian chief. As one of the pathfinders and pioneer measurers of a largely unsettled province he endured exceptional hardships. His accomplishments were remarkable and his career a most constructive one. His extensive diaries, field notes and correspondence, now in the keeping of the Public Archives of Ontario and of the provincial Surveys and Maps Office in Toronto, form a priceless source of information on early days in central Canada.

The protection of boundary marks has occupied the attention of law makers and law enforcement agencies since the origin of private ownership of land. In few places in the world, however, have the penalties for removing or damaging survey boundary monuments in relation to private property been so severe as those imposed in Upper Canada at the end of the 18th century. In a statute passed in 1798 (U.C. 38 George III ch. 1, sec. 4) it was provided that "if any person or persons shall knowingly and wilfully pull down, alter, deface or remove any such monument as aforesaid, he, she or they shall be adjudged guilty of felony, and shall suffer death *without benefit of clergy*". (author's italics)

By 1849 this offence had been reduced to a misdemeanor and the death sentence reduced to a period of imprisonment. In any event, as far as is known, nobody was executed in Upper Canada under this law. The phrase, "without benefit of clergy" has been much misunderstood. It does not mean that anyone under sentence of death, in such a case, is deprived of spiritual comfort. The roots of this expression are deep in English criminal law and the phrase represents a form of court pleading. In the 12th century any member of holy orders who broke the criminal law obtained exemption from punishment inflicted by lay courts by submitting proof that he was, in fact, a member of the clergy.[14] By 1350 the standard test of such status involved the ability to recite the opening words of the first verse of Psalm 51: "Have mercy upon me, O God, according to thy loving kindness. . . ." This passage of the Scriptures became known, in time, as the "neck-verse". This test was abrogated in 1705. Until the practice was finally abolished for all commoners in 1827, it had been widely exercised. Whenever it was intended that a breach of statute was to be punished with the utmost severity, the words "without benefit of clergy" were added as part of the penalty.

Soon after the passage of this highly punitive 1798 measure, a surveyor who achieved considerable distinction in his profession, began to practice in Upper Canada. His father, a zealous Loyalist named Thomas Sherwood, was reputed to be the first settler in the United Counties of Leeds and Grenville. He located on Lot No. 1 in the first concession of Elizabethtown in June, 1784. He became a magistrate and captain in the militia. As a man of some education he was often called to run sidelines of lots for other pioneer settlers. His son, Reuben Sherwood (1775-1851), conducted township surveys as early as 1799. From 1809 to 1820 he was employed on government surveys subdividing such townships as Augusta, Bastard, Bathurst, Lansdowne, Leeds, Marmora, Nelson, Pittsburgh, Sherbrooke, Nassagawega and Yonge.

In later years some of the surveyors who served their apprenticeships under Reuben Sherwood included John Stoughton Dennis, later to become Canada's first post-Confederation Surveyor General, Richard Birdsall, John McNaughton and W. Harry Kilborn. Excerpts from Sherwood's diary, an account kept during his surveys of Nelson and Nassagawega townships, afford revealing glimpses of surveying conditions at the end of the second decade of the 19th century:

"Saturday, March 13, 1819: Snowing again in the morning. I go out with the party and finish the 2nd concession line to 15 and road. Return again at 7 p.m., find Hudson arrived. An exceeding cold night; about 15 inches on the ground. Break my compass glass in coming home.

Sunday, March 14: A cold day. The boys go out and bring 3 packs of biscuits in and all get drunk. . . ."

Another Upper Canadian surveyor who came into prominence near the turn of the century was Thomas Ridout (1754-1829). An English-born Loyalist who first settled in Maryland, he was captured by Indians in 1787. This occurred at a time when savages of that region were in the habit of cruelly torturing any white prisoners. Ridout was fortunate to escape with his life. He came to York with his family in 1797 and was employed in the office of Surveyor General Smith. He became the representative of Simcoe, Durham and the east riding of York in the provincial House of Assembly, 1812 to 1816. In 1804, when Smith (who had served as Speaker of the House in 1797 and 1801) retired to England, eventually (1821) to be created a baronet, Col. William Chewitt, already once rebuffed in the realm of advancement, discovered to his chagrin that although he had been promised the Surveyor Generalship, Smith had been succeeded by Charles B. Wyatt. After the latter was suspended in 1805 on charges of conspiracy, Chewitt was appointed to the post jointly with Thomas Ridout. It would not appear to have been a wise arrangement but this dual occupancy continued until 1810 when Ridout was accorded the full and undivided title, holding it until 1829.

Only four others held the position of Surveyor General of Upper Canada until the post was abolished (later to be revived) in 1845 (8 Victoria ch. 11, sec. 1) when his department and office were consolidated under the Commissioner of Crown Lands. These four were: Hon. Samuel F. Hurd (1832-35); J. Macaulay (1836-38); Robert B. Sullivan (1838-40); and Thomas Parke (1841-45).

Samuel Ridout (1778- ?), son of Thomas, was employed in his father's office as chief clerk to the Surveyor General and was appointed a Deputy (Provincial) Surveyor about 1810. Twice married, Samuel owned and occupied a farm abutting on Yonge Street in the area now known as Summerhill.[15]

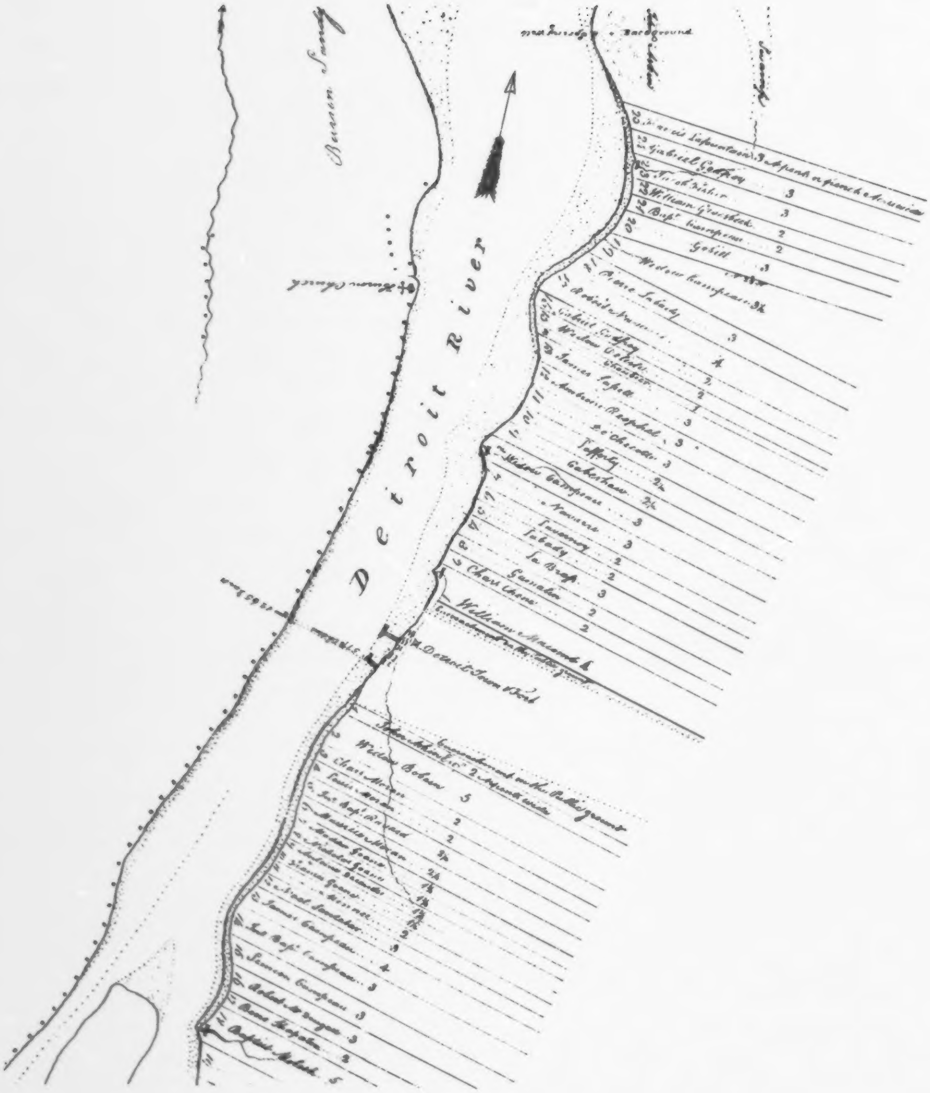
By his decision to establish counties in Upper Canada, Simcoe sought to serve a basic three-fold purpose; to promote loyalty to the Crown, to establish the framework of an effective democracy, British style, and to provide a basis for representation in the House of Assembly. He felt also that the division into counties would serve to unite and blend the several districts of the province.

Even the settlers preferred names to mere numbers, encouraging Simcoe to indulge in 1792 in an orgy of place-naming. In the eastern reaches of Upper Canada he bestowed county names from local sources or developments; Leeds, Stormont, Dundas, and Glengarry. He used English county names methodically, applying that nomenclature along the Canadian shores of Lake Ontario and Lake Erie. Thus in the Niagara Peninsula we find Lincoln county; west of the Bay of Quinte, Northumberland county, and on Lake St. Clair, Kent.

Under Simcoe also an ambitious start was made on systematic road-building in the province. Yonge Street, named after Sir George Yonge, British Secretary of State for War (1782-94), was surveyed by Jones and Stegman and built by the Queen's Rangers, from 1794 to 1796. The road extended more than 30 miles, designed to link Lake Ontario and Lake Simcoe. In addition, Dundas Street, planned by Simcoe as a trunk military highway running east-west across the province, was partly laid out by Jones and constructed by the Queen's Rangers in 1794 and 1795.[16] This highway was more popularly known as the Governor's Road and later as Dundas Street. Its route includes today's main streets of Woodstock and London. Thus the highways Simcoe caused to be surveyed have become some of the principal traffic arteries of present-day Ontario. In addition to its military aspects, Dundas Street, in Simcoe's plans, was to help build up London as a potential capital of the upper country. The Governor General had other plans, however, and Simcoe was instructed to establish York as the seat of government.

The Niagara Portage Road was surveyed and constructed also before the turn of the century. When Augustus Jones surveyed the Canadian bluffs overlooking the famous falls and river he reserved a strip one chain in width along the crest of the bank, for road-making purposes. This became a highly popular travel route and by the end of 1791 was carrying all west-side traffic.

Following Simcoe's departure from Canada in 1796 roadwork in the upper country declined and settlement progress fell off proportionately. In 1800, in fact, immigration had fallen so far behind completed surveys that Lieut.-Governor Hunter directed the whole of the lands surveyed in the province to be settled *before* any new surveys would be undertaken. During the entire period of the Loyalist influx the only substantial body of immigrants to enter Upper Canada from the British Isles was the Glengarry Fencibles, who came in 1804. At this time the population of Upper Canada was estimated at 40,000.


Detroit River
Detroit Town & Fort

MAP 29. A section from Patrick McNiff's plan of the settlements at Detroit, 1796. Courtesy of The Clements Library, Ann Arbor, Michigan.

Kingston had 600 inhabitants and York, 500.[17] But within the first decade of the 19th century a combination of dynamic factors served to alter the face and future of the province. Within the following half-century both road-building and settlement received a powerful impetus.

Col. Thomas Talbot (1771-1853) was one of these formative factors. Born in Malahide County, Ireland, Talbot joined the British army as soon as he was of enlistment age and in 1790 was sent to Canada. By 1792 he had been appointed private secretary (aide) to Simcoe. When he returned to England in 1794 he resumed his military career and rose to the rank of Lieutenant Colonel. But Talbot could not rid himself of the visions stirred by his glimpse of the constructive opportunities offered by Canada and in 1802 he sold his army commission, and induced the British government to grant him a large acreage in Upper Canada. With remarkable single-mindedness combined with ruthless energy and unusual administrative talents, Col. Talbot rapidly became one of the most outstanding colonizers of British North America.

In his various settlement projects he had the valuable assistance of Lieut.-Colonel Mahlon Burwell (1783-1846) in the role of surveyor. In the earliest days of Upper Canada military men predominated in the surveying field, probably because of the scarcity of properly qualified civilians. Burwell was among the vanguard of Talbot's Loyalist settlers, arriving from New Jersey. In 1809 he located at a place now known as Port Talbot. His knowledge of practical mathematics made him highly useful and much in demand as a surveyor in the wilderness districts. He was named a Deputy (Provincial) Surveyor in 1809 and became a close associate of Talbot. He was instructed to lay out the Talbot Road (or Street), an important element in Talbot's strategy for developing his lands and settlement schemes.

Burwell had his problems. For his road survey party he tried to recruit axemen, chainmen and picketmen at the then prevailing official wage rates of 1 shilling, sixpence a day (Halifax currency). He found it very difficult to interest anyone at such rates. Finally he persuaded the government to pay his men 1 shilling a day extra. Burwell received 5 shillings a day, later increased to grants of land up to 4½ per cent of the acreage he surveyed.

Survey instruments available in those times in Upper Canada would be considered today as very primitive, a circumferentor and a chain of up to 100 links. As an indication of the peculiar problems and privations faced by pioneer surveyors it is recounted that in 1800 in surveying along Dundas Street, James Hambly (or Hanvey) was left in a state of shock when his circumferentor fell from a stump and the needle broke. He was compelled by this mishap to make a long journey on foot to Victoria village, the home of John Bostwick (1780-1849) to obtain the services of that surveyor to repair the damaged instrument. Hambly, who contracted grippe as a result of fording cold spring freshets and swollen streams, lay sick in Bostwick's quarters for several days. All the while he was tormented by visions of his idle field men, drawing wages and eating all too heartily at Ingersoll Inn. In the field the food was simple and sustaining but somewhat monotonous; salt pork, pea soup and bread supplemented by fresh fish and fowl.

The practice in the field at that time was for the surveyor to set up his circumferentor on a level stump or flat rock and take a sight along the intended township base line. Axemen cut away obstructing trees. One chainman held the first link over the stake at the starting point. The second chainman carried and opened up the remaining 99 links of the chain to a point determined as precisely correct, the surveyor then signalling the picketman to drive in a stake at that point. At the termination of every fourth lot, a span of one chain was provided for a future side-road. As he came to each creek or swamp the surveyor recorded the feature in his field book. He entered also the quality of the soil, number of rock outcroppings and types of timber.

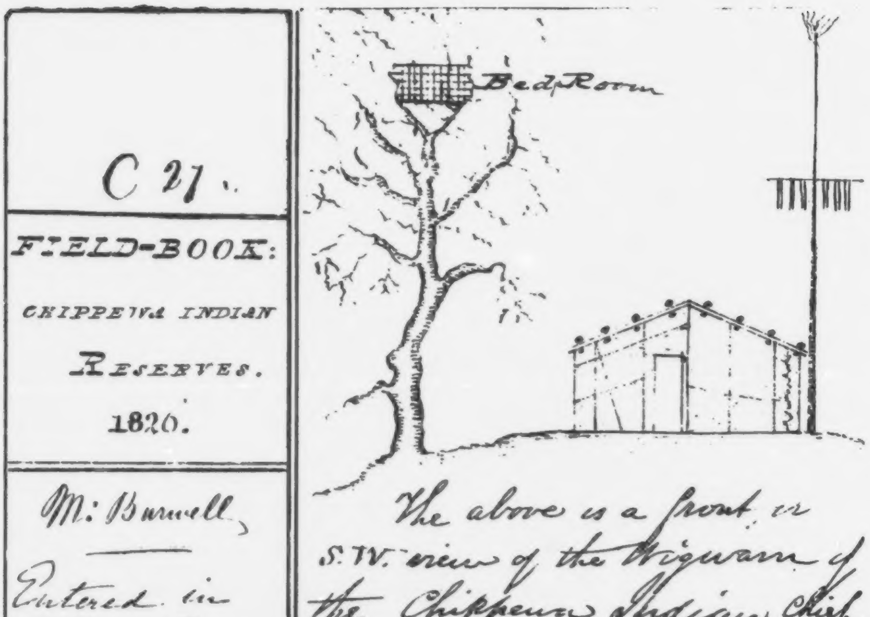
Col. Burwell, as government surveyor, often chose to be paid for his services in land grants rather than in cash. In this way he became the owner of thousands of acres of choice farmland in the western townships. For example, in Southwold township he obtained 600 acres near present-day London, where he settled in 1815. In the spring of 1810 he had commenced the survey of London township, laying out lots on Dundas and beginning "the Proof Line of the work", now Richmond Street in London. By June 13 he had completed the survey of the lower part of London township as far as the 6th concession. In spite of rheumatism Burwell could not forget his military background and in his diary writes of "marching my men" from one point to another. The War of 1812 interrupted these measuring activities but with the coming of peace Burwell resumed surveys in the London area. The township occupied his full attention during the autumn of 1818 and the spring of 1819. Often makeshift wigwams of bark and branches afforded shelter for the survey party at nights. In 1819 Burwell and his men were overtaken by a heavy rainstorm and "soaked to the skin. We could not get the bark off the trees". From such ordeals came occasional casualties as illnesses depleted survey party ranks. In addition Indian assistants would leave abruptly to attend tribal pow-wows. But by May 11, 1819, with the help of his brother Lewis, Mahlon Burwell completed the London township surveys.

At about this stage in the development of Upper Canada surveys a third method of measuring land was introduced, known as the *double-front system*. Under the single-front system (1783-1818) a typical lot contained 200 acres. Under the front-and-rear system in the Niagara Peninsula (1787-1813) each lot, as a rule, contained 100 acres. Under this third method, 200-acre plots were allocated to settlers and the Crown grants were made generally in one-half lots of 100 acres. In order that settlers might properly locate limits for the back 100 acres, a double-front system of corner posting was introduced. This method of laying out land prevailed from 1815 to 1829. About 100 townships in the province were surveyed in accordance with this third system.

Not long after Burwell's achievement in the London area, the survey authorities at York realized, none too soon, the need to maintain a standard or uniform size for lots and concessions. In the spring of 1829 Surveyor General Ridout submitted a report to Lieut.-Governor Sir John Colborne, recommending adoption of what has become known as the *2,400-acre block system*, in effect from 1829 to 1851. Chronologically this was the fourth system of surveying land out of a total of seven applied in what is now Ontario. Ridout's plan was approved by order-in-council on November 27, 1829, thus instituting the first of the so-called sectional systems, an adaptation of the double-front. When surveyed under the Chewitt proposal the township was divided into blocks two concessions deep and six lots wide, 12 lots of 200 acres, or a total of 2,400 acres. Later on in the 19th century the subdivision on Canada Company lands was accomplished under the 1,000-acre section plan, the fifth system, but about 50 townships were laid under the fourth or Chewitt system.

The period 1815-40 represented the peak of Col. Thomas Talbot's influence and authority.[18] Although he would not claim to be above all reproach, the hamlet that sprang up near Kettle Creek about 1817 was named St. Thomas in his honor, as was nearby Talbotville. The St. Thomas *Liberal* was not impressed by Talbot's "saintliness" and editorially observed "that Colonel Talbot rules with a more absolute sway and his power is infinitely more to be dreaded than that of the King of Great Britain".

Talbot made a personal enemy of Simon Zalotes Watson, a pioneer surveyor in



C 27.

FIELD-BOOK:

CHIPPEWA INDIAN

RESERVES.

1826.

M: Burwell

Entered in
Field Book
Vol. 20. Fol. 525

The above is a front or
S.W. view of the Wigwam of
the Chippewa Indian Chief,
Chemokomon at the extremity
of Kettle Point on Lake Huron
as also of his Flag Staff & bed
room in the top of a large Oak
Tree so high as to be proof
against musquetoes in Summer
nights.—

FIGURE 30. Spine of a Burwell Field-Book, 1826, and extract from a page therein.

both Lower and Upper Canada. A one-time magistrate in Montreal, the American-born Watson had been active as a land surveyor as early as 1792 in the Eastern Townships.[10] He came to Upper Canada and was made a Deputy (Provincial) Surveyor for the upper country on May 2, 1810. In June of that year Watson surveyed the first and second concessions of Westminster township in the London area. Also in that year he surveyed Commissioners' Road, named after the group appointed by the Crown in 1804 to supervise road-building in the province. The first commission included Thomas Talbot, John Bostwick and Moses Brigham. Watson also surveyed Base Line Road, now within London city.

For a time Watson was in Talbot's good graces and became associated with him in settlement projects. This was his undoing. Misunderstandings arose over the scope of Watson's authority and Talbot repudiated him. The embittered Watson joined American invaders in the War of 1812 and in July of that year General Brock wrote unofficially that enemy cavalry "was being led by one Watson, a surveyor from Montreal, a desperate character".

Pioneer surveyors of the London area, in addition to Mahlon Burwell, John Bostwick, Simon Z. Watson and James Hambly, included Sam Peters, Charles Rankin and John McDonald. A survey of a town plot at the fork of the Thames in 1826 marked the beginning of the town of London as distinct from the township.[20]

In accordance with Talbot's settlement plan, as suggested to Lieut.-Governor Maitland, an order-in-council was issued for the survey of a road to connect the settled concessions of London township with the main road. The surveyor was instructed to lay out farm lots of 100 acres on each side of the highway. Talbot was to arrange for the sale of these lots at 12½ shillings an acre.[21]

On June 29, 1826, Burwell sent to Surveyor General Ridout his newly-completed plan of London, containing 240 acres, bounded by Wellington Street on the east, and on the north by Carling and Queens Avenues, both then known as North Street. He reported that the "most eligible and beautiful scite [sic] for public buildings" was near the centre of the block composed of lots numbered 21 to 24 on the south side of Dundas Street and exending south to King Street.

Thomas Talbot died in Brant county on February 6, 1853, the same year in which the first Great Western train entered London. Talbot had turned the first sod on this historic railway-building project a few years earlier. Talbot's dynamic achievements in colonization created wide interest overseas in the agricultural possibilities of the upper country. Outstanding as Talbot was in the panorama of Canadian development, the name of Mahlon Burwell, his land surveyor in chief, will always remain closely linked with that of his principal employer. His pioneer surveying is commemorated in the name of a community he laid out in 1830, Port Burwell on Lake Erie, fittingly located in relative proximity to Port Talbot.

Other factors of special significance in providing impetus, scope and direction to immigration into Upper Canada were two highly ambitious English land companies, authorized to help develop the province. The Canada Company, incorporated June 27, 1825, and granted a Royal Charter in 1826 (6 George IV, ch. 75) played a key role in opening up midwestern Ontario. The Canadian Land and Immigration (sometimes Emigration) Company, incorporated in London, England, on April 15, 1861, served to develop the Haliburton district. An odd coincidence connected with these corporate activities is that in each case the company was directed by a gentleman of literary, rather than of promotional or administrative experience. John Galt, founder and first superintendent of The Canada Company, was a poet, biographer, historian, essayist and novelist. Hon. Thomas C. Haliburton was well-known as a Nova Scotian author and creator of "Sam Slick". The appearance of The Canada Company in the upper country was the signal for a strong revival of highway construction, especially of colonization roads in the more central and westerly parts of the province. One of the most important of these was the Huron Road, in the building of which contractor Col. Anthony Van Egmond played a major role in 1827.

The Talbot Road, already described, was surveyed first, in 1804, by the Massachusetts-born Lieut.-Colonel John Bostwick (1780-1849). He laid out some of the earliest roads of the Talbot Settlement and founded Port Stanley. Parts of the Talbot Road were

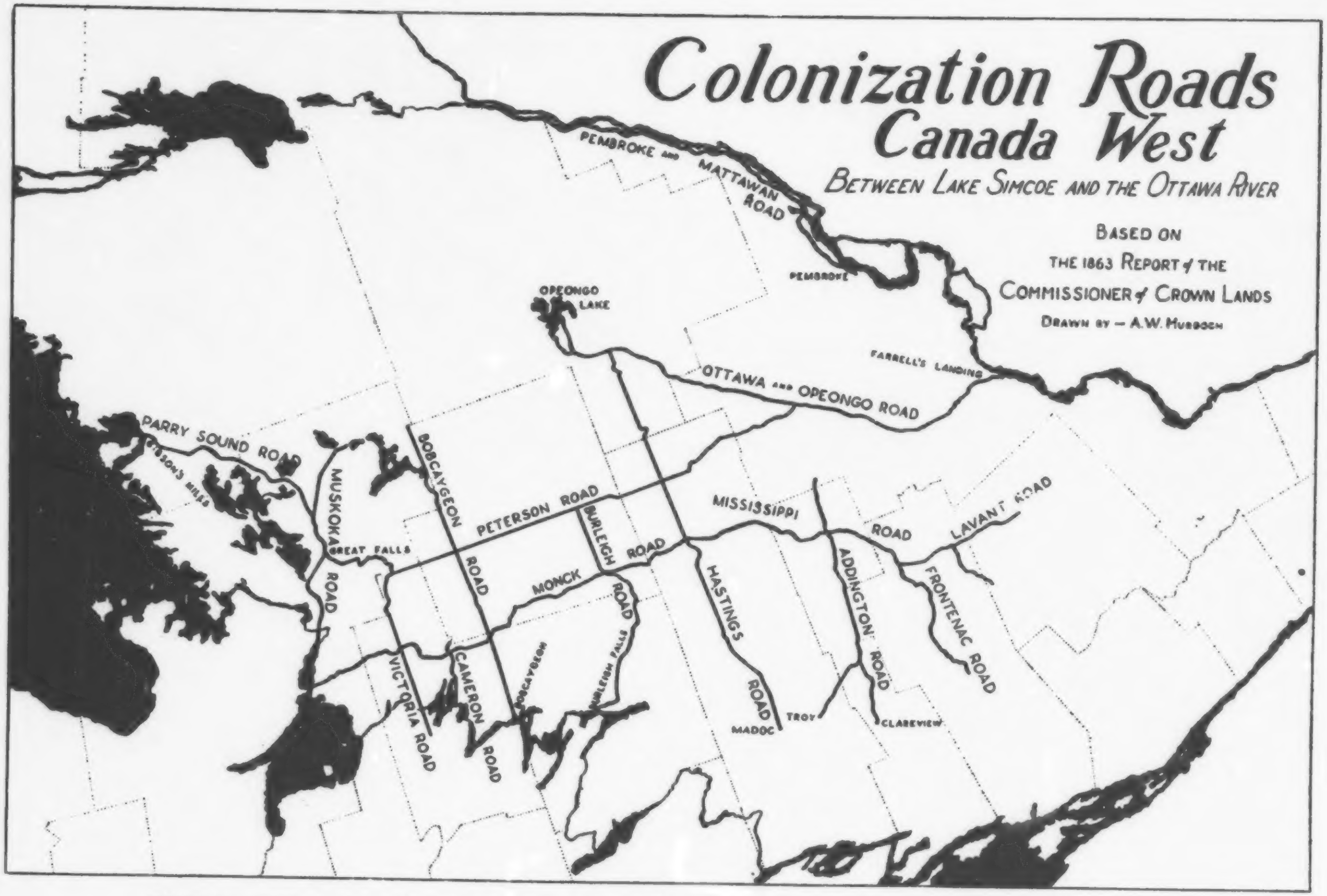

Colonization Roads
Canada West
Between Lake Simcoe and the Ottawa River
Based on
the 1863 Report of the
Commissioner of Crown Lands
Drawn by – A.W. Murdoch
Pembroke and Mattawan Road
Pembroke
Farrell's Landing
Opeongo Lake
Ottawa and Opeongo Road
Parry Sound Road
Muskoka Road
Great Falls
Bobcaygeon Road
Peterson Road
Burleigh Road
Monck Road
Mississippi Road
Lavant Road
Hastings Road
Addington Road
Frontenac Road
Victoria Road
Cameron Road
Bobcaygeon
Burleigh Falls
Madoc
Troy
Clareview

FIGURE 31. Colonization Roads, Canada West, based on the 1863 Report of the Commissioner of Crown Lands.

surveyed by Burwell in 1809. Two years later he was instructed to extend the road to Amherstburg and to survey branches of it connecting with settlements to the north. The existence of that road, completed in 1811 and improved in 1826, meant more rapid colonization of the north shore of Lake Erie. This Talbot Road was, in fact, considered the best road in Upper Canada in the 1820s and 1830s.

The 75-mile-long Garafraxa Road that eventually extended from Fergus through Arthur, Mount Forest, Durham and Chatsworth to Owen Sound, constituted another major colonization road and was surveyed from 1837 to 1839 by Irish-born Charles Rankin (1797-1886). Appointed a Deputy (Provincial Land) Surveyor in 1820 he worked initially in the southwestern part of the province. In 1833 Rankin began surveying Nottawasaga Bay area and settled on 200 acres west of the present town of Thornbury. In addition to his Garafraxa Road project Rankin surveyed Owen Sound and Southampton townsites as well as the Muskoka Road.

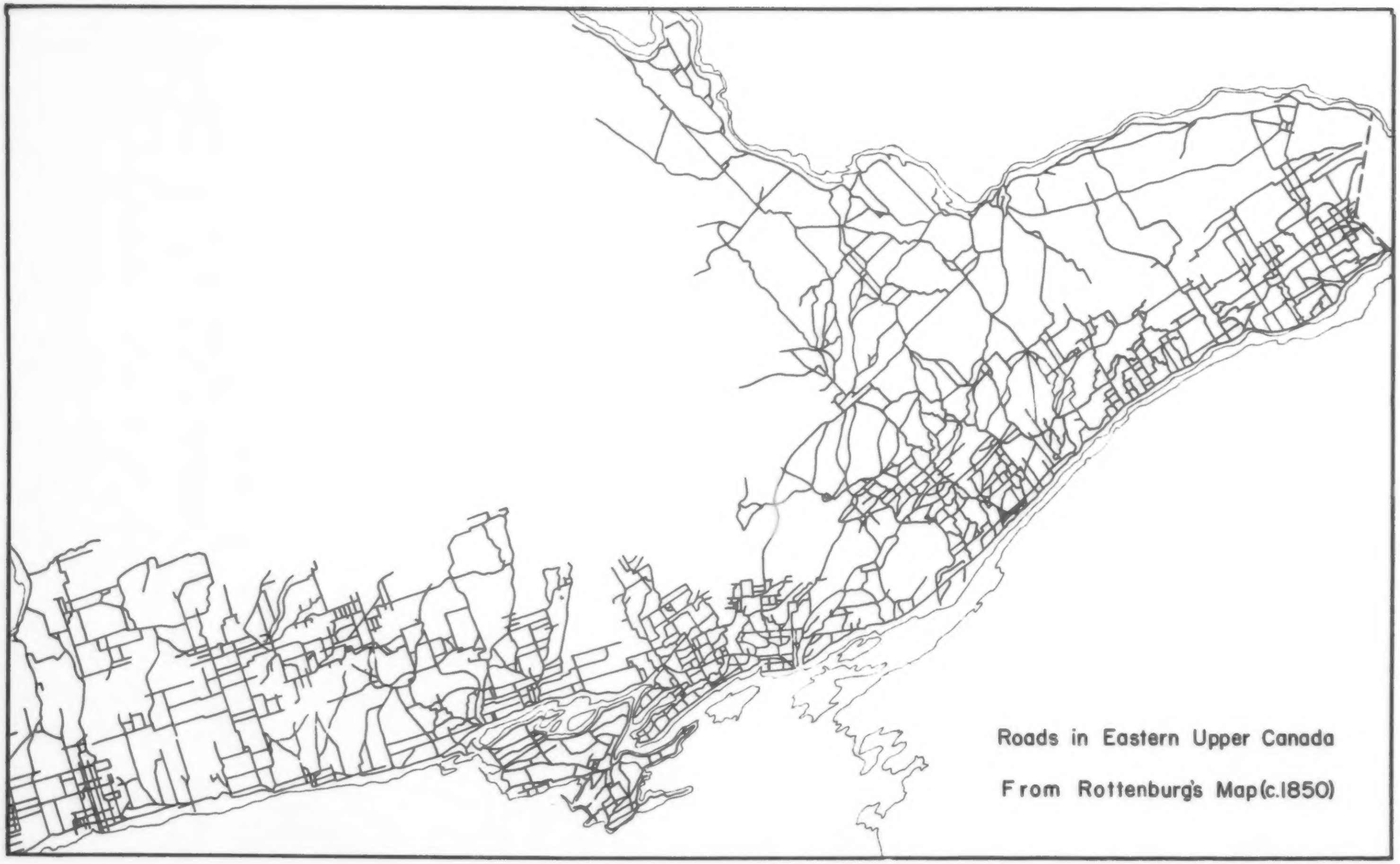
The Garafraxa Road, built from 1840 to 1848, and the Muskoka Road, completed in 1858, were followed by a momentous decision of government to open up for settlement the vast Ottawa-Huron country. This fact, with the advent of the Canadian Immigration and Land Company, brought about the construction of several colonization roads, including the Bobcaygeon and Peterson Roads, both completed in 1862. There were colonization roads of somewhat lesser significance constructed during this same settlement epoch, such as the Ottawa-Opeongo, the Addington, Victoria, Burleigh, Hastings and Frontenac-Madawaska Roads. It was a busy time for highway surveyors!

By 1850 there was in existence in Canada West a fairly complex system of roads of all types. In addition to colonization roads and such routes as the Niagara Portage, Yonge Street and Dundas Street arteries, there were the heavily-utilized highways in the province's midwestern sector such as that part of the through road, London to Sarnia, known as the Egremont Road (1840), Guelph Road (1819), Commissioners' Road (1804), the Base Line Road and Proof Line Road (1824). The last three arteries served the people of London and Middlesex county. By 1866 a beginning was made on a county highway system.

The million-acre section of The Canada Company's domain known as the Huron Tract had been acquired by purchase from the Six Nations Indians. For this vast region the Company contracted to pay two-thirds of its value in cash (£145,150 and 5s.) and provide the balance in the form of improvements such as roads, bridges and wharves.[22] The development of this region and the provision of improvements resulted in the employment by the government of Upper Canada (at the request of the Company) of a sizable platoon of qualified surveyors, one of the most notable being John MacDonald. But John Galt himself must have mastered at least the rudiments of land surveying. With a company associate, Dr. William Dunlop, he laid out the site of Goderich. The site of Guelph, founded in 1827, was also selected by Galt. By midsummer of that year surveys had reached the townsite of Galt. Hon. William Dickson, a Scot and former schoolmate of John Galt, named the place after the Canada Company superintendent.

A road from Guelph to Goderich was cut through the bush and communication established for the first time overland between Lake Ontario and Lake Huron. Townships along this road were named after Company directors such as Ellice, Logan, and McKillop. Galt's policy was to open up roads and render lands more readily accessible. In his autobiography Galt describes the road-making process:

"All the woodmen that could be assembled from the settlers were directed to be employed, an explorer of the line to go at their head, then two surveyors with compasses, after them a band of blazers, of men to mark trees in the line, then went the woodmen



Roads in Eastern Upper Canada

From Rottenburg's Map (c.1850)

Figure. 32.

with their hatchets to fell the trees and the rear was brought up by waggons with provisions . . .".[23]

Galt, described as a very tall man (six feet, four inches) with black hair and keen eyes, may have lacked business acumen. But he had a vision of Canada's future possessed by few of his generation. Today monuments to his foresight are impressive: the cities of Guelph, Goderich, Galt and the Huron Road. He supervised the drainage of swamps, the damming of rivers, the building of bridges, clearing of forests, the endowing of hospitals and the founding of important communities. The immigrants he attracted to Canada were of the desired and needed quality; they were men, women and children whose worth was beyond mere counting. Canada, as John Galt saw it, was "the most beautiful country in the world".

Lots 20 chains by 50 chains represented the general arrangement in the Tract, fronted on both sides of concession roads and extended to a blind rear line. Side roads were provided every fifth lot and these bounded the ends of blocks a mile and a quarter square, each containing 1,000 acres. This was the fifth system of land surveying put into effect in Upper Canada, namely, the *1,000-acre section system*. It was first applied in 1835 and continued to 1906. About 1850 this system, which had proved highly popular, was adopted for Crown surveys also,[24] except that the government introduced the placing of a one-chain-wide road allowance along the banks of rivers and lakes. This practice has been continued since. Some 200 townships were surveyed under this system, representing the largest area of Upper Canada subdivided up to that period, according to one pattern. It was a system designed to apply to agricultural lands, not for hilly or rocky country, full of lakes.

Highways, overland links between communities, were keeping pace with settlement, if not preceding it. But canal projects were not neglected. The idea of joining Lakes Ontario and Erie by a canal sprang into men's minds at the outset of exploratory surveys. Col. Robert Nichol, a member for Norfolk in the House of Assembly, introduced a bill in 1816 to provide funds for a survey of possible man-made water routes between the two lakes. William H. Merritt, a mill owner, took time by the forelock in 1818. He borrowed a water level and began a survey of the height of land separating the headwaters of Twelve Mile Creek from the nearest point on the Welland River. As a result of that survey the Assembly granted £2,000 for a proper survey, including any canal prospects along the St. Lawrence River. But not until 1823 did Merritt get his actual survey. Many were opposed to the whole idea. Some, like William Chewitt, feared that proximity of the undertaking to the United States would jeopardize it. A survey by Hiram Tibbetts, a civil engineer, proved favorable and Merritt was authorized by an Act passed January 19, 1824, to incorporate the Welland Canal Company.

Early surveyors in the region often found marsh water unfit for drinking because of a plenitude of waterbugs, so the men were kept supplied with whisky, served from tin pails with tin dippers. Whisky at the time cost 25 cents a gallon. Progress on these canal surveys was, therefore, remarkable and it might be added, at times exhilarating. But in other parts of Canada superabundant supplies of whisky at such low prices aggravated troubles such as the Roman Catholic-Protestant feuds, if it did not actually cause them.

From the advent of the white man in the upper country of 19th century Canada the Trent Valley was regarded as a principal traffic route between Lake Huron (Georgian Bay) and the eastern end of Lake Ontario. English-born Richard Birdsall (1799-1851) was among the more prominent of the early land surveyors in the region, having laid out the townsite of Peterborough under Z. Burnham, in 1825, as well as parts of various townships before and after that year. Frances Stewart, a settler's wife with literary gifts, in one of her 1823 letters to friends in England (Our Forest Home, 1902, Montreal), written in Duoro township, recounted vividly how, ". . . one very wet day I saw two men walk past my window; one had a blanket about his shoulders, a pair of snowshoes in his hands, and a small fur cap. The other was dressed in ragged sailor's clothes. I took the foremost for an Indian . . . but to my surprise . . . found this was Mr. Birdsall, a very smart young Englishman, who is surveyor of the township in this district, and his assistant; they had five other men with them as chainbearers, etc. I found that they had all been living in the woods for the months of March and April, which accounted for the ragged and weatherbeaten appearance of the whole party".

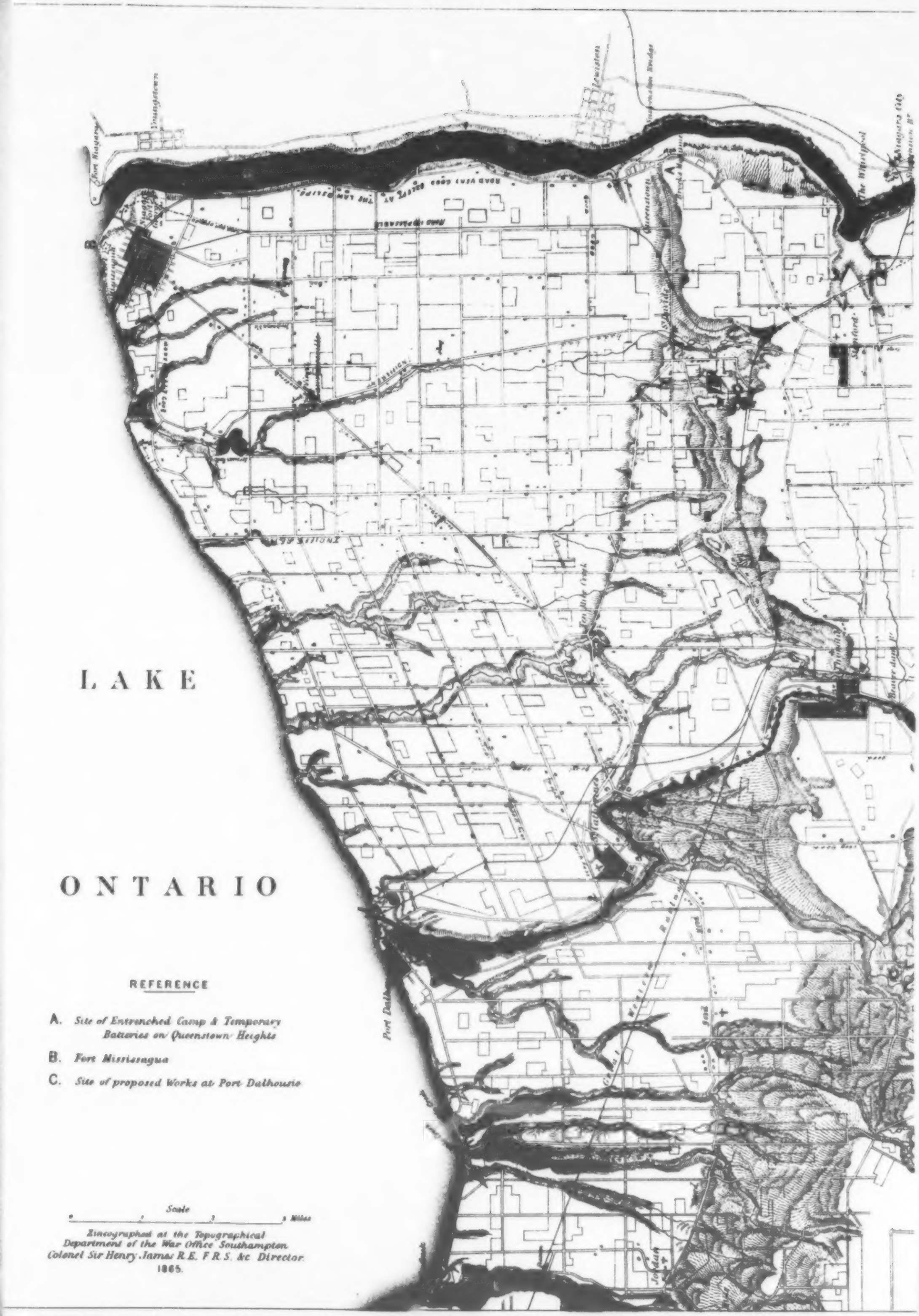
From the closing years of the 18th century reports, maps and surveys had been produced for the purpose of enabling government authorities to decide whether the Toronto Portage was a better way to Lake Simcoe than the Trent system of waterways between the Bay of Quinte and Lake Simcoe. As early as 1790 a map, dated October of that year, and signed by Holland and Collins, contained manuscript notes on portages along the Trent.[25]

In 1819, one year after the first settlement in the "back townships" had taken place (surveys of Smith township were completed in 1818) Lieut. J. P. Catty of the Royal Engineers conducted a survey in the Trent region and refers to his journey to the Bay of Quinte as "more tedious and less satisfactory than might have been expected". Other early surveyors in the area were E. C. Caddy (1815-97) Deputy (Provincial) Surveyor and artist; also F. P. Rubidge (1806-98), surveyor and poet, who was instructed in surveying by Major Samuel Wilmot. In 1835 Rubidge surveyed for the Cobourg Rail Road Company and also in several of the more northerly townships in the valley of the Trent. In particular he examined the country between Rice Lake and Lake Simcoe. The various watercourse projects in the Trent system came to be known as the Trent Canal. This chain of lakes, rivers and canals occupies a considerable part of the counties of Hastings, Durham, Northumberland, Peterborough, Haliburton and Victoria.

Not all early canal surveys in the upper country can be considered in this chapter but mention should be made of the Murray Canal near Presqu'isle in Lake Ontario. Surveys extending from those of Jones in 1792 to those of Birdsall and Walkins in 1824 favored a canal project in that vicinity. After 1794, it is said, nearly every representative of the East Riding of Northumberland swept into office on the sure promise of the Murray Canal. But following electoral victory the pledge was forgotten. The first sod, however, was turned on this project on August 31, 1882, and the canal was ultimately completed.

As early as October, 1783, a Lieut. French headed an exploratory survey party in the Rideau Lake country as far as the Ottawa River. His report, likely the first one written that foreshadowed the establishment of an artificial waterway connecting the Ottawa River and Kingston by the Rideau Lakes, preceded by ten years an investigation by John Stegman. In 1793 Stegman surveyed in an area later covered by the four townships, Osgoode, Gloucester, North Gower and Nepean. A Rideau River country legend, rooted in questionable premises, told how Stegman, just before his death by drowning, planted his last survey stakes near Dow's Great Swamp, now Dow's Lake in central Ottawa.

Not until 1809 did first signs of settlement appear in the proximity of the junction of the Rideau and Ottawa rivers, on the south bank. Ira Honeywell, Braddish Billings and Nicholas Sparks located in small clearings, facing a sea of oaks, elms, beech and hemlocks. What was eventually to become the central area of Canada's capital city was then mostly forest, beaver-meadow or swamp. Sparks' farm extended across what is now


Fort Niagara
Youngstown
Lewiston
Suspension Bridge
Niagara City
The Whirlpool
Queenstown
Stamford
LAKE
ONTARIO
Port Dalhousie
REFERENCE
A. Site of Entrenched Camp & Temporary Batteries on Queenstown Heights
B. Fort Missisagua
C. Site of proposed Works at Port Dalhousie
Scale
0 1 2 3 Miles
Zincographed at the Topographical Department of the War Office Southampton
Colonel Sir Henry James R.E. F.R.S. &c Director.
1865.

CARTE 30. Levé des plans de fortifications à la frontière constituée par le Niagara. Tiré de croquis du capt. Stotherd du lieut. Price et du lieut. Halet, 1er bataillon de grenadiers, 1862-1863. Archives publiques du Canada.

the heart of downtown Ottawa. Across the river from the "curtain" falls marking the descent of the Rideau into the Ottawa, American-born Philemon Wright (1756-1839) provided pioneer leadership in colonization and other activities. Wright, a Massachusetts stock-breeder, became interested in purchasing four townships in the vicinity of modern Hull. These townships were Hull, Rippon, Harrington and Grandisson. In March, 1797, on coming to inspect the land involved in this deal, Wright found that only Hull township was suitable for settlement. In the following month he filed a petition at Quebec City for a warrant of survey. But not until four years later was official action taken in the matter. In 1801 Wright was engaged to make a plan of Hull township and during the year following he claims to have surveyed the entire area "placing 377 square posts in a township of 82,429 acres". In all likelihood Wright meant that he employed surveyors such as P. H. Smith.

Philemon Wright was exceedingly active in other fields as well. He constructed the first Aylmer Road and built the first steamboat to ply the Ottawa River. A quarter-century later he played a valuable role in the construction of the Rideau Canal. He represented his county in the Legislative Assembly of Lower Canada from 1830 to 1834. As settler, surveyor, colonizer, entrepreneur and man of affairs Wright accomplished much, in 40 years, to help transform a primitive place into the most important, lively and productive community on the north bank of the Ottawa, from the river's source to its mouth near Montreal.

Surveys other than those of Lieut. French and John Stegman contributed to the shaping of the destiny of the then nameless settlement on the south bank opposite Hull. From April to June, 1816, Lieut. Joshua Jebb, R.E., examined and reported on the Rideau River country. In 1824, Samuel Clowes, instructed by an Upper Canada government (Macaulay) commission to conduct a survey in the region, reported his findings. His report was forwarded to London, England, through the Governor General, in 1825. The Smyth commission, appointed by the British government, accepted Clowes' line and his calculations of levels involved. The commission recommended that a canal be built, primarily for the transport of troops and military supplies along the proposed route, relatively unexposed to U.S. aggression.

Developments followed swiftly on the tendering of this advice. Lieut.-Colonel By of the Royal Engineers was selected to take charge of the Rideau Canal project and to utilize all efficient methods to push it to a speedy conclusion. He landed at Quebec on May 30, 1826, and at the proposed canal terminus on the Ottawa, on September 21 of that year. When By arrived on the Ottawa site Philemon Wright, still a fine figure of a man at an upright six feet, had reached the age of 70. MacTaggart, Col. By's Clerk of Works, reached Bytown, as it was called in honor of the officer in charge of the canal project, in October, 1826.

Two companies of Royal Sappers and Miners, of 81 men each, arrived and camped for a time under canvas on Nepean Point. MacTaggart apparently was sufficiently trained to survey alternative routes for the 'Big Ditch'. In June and July, 1827, MacTaggart with 8 men launched his survey. Also in 1827, during July and August, Lieut. Pooley of the Royal Engineers conducted an intensive canal survey. MacTaggart and his party struggled valiantly for three days across a distance traversed today by the canal from the Chateau Laurier to Hog's Back, about 4 miles. Heavy bush and soggy footing forced MacTaggart to wait for the freeze-up. Even so, the deep snows of the winter of 1827-28 made progress very slow over what is now the Glebe area and Ottawa South. His account of this surveying experience has survived.[26]

On September 26, 1826, Lord Dalhousie, Governor in Chief of British North

America, placed in Col. By's hands "a sketch plan of several lots of land" he, the Governor, had purchased for the Crown to serve as "a site of the head of locks and for such villages and other settlements as might be needed to house construction workers". Upper Town, as it was named, was laid out first, in mid-October, 1826. Lower Town was located on Crown land also. Contemporary plans reveal that not only one-half mile of unoccupied property separated the two settlements but also the canal excavation itself.

On August 16, 1827, an occasion significant to our story took place in Bytown when Capt. John Franklin, returning from the Far North of Canada, laid the first stone of the Ottawa locks of the Rideau Canal in a brief, happy and formal ceremony.

Lord Dalhousie had personally selected, after examination on the spot, the site of the canal locks leading into the Ottawa River, and had confirmed his choice by letter dated September 26, 1826. That day might well be regarded as Ottawa's date of founding.

In the face of many hard ordeals, including lethal "swamp fever", a type of malaria that killed many workers, nearly ended By's life and compelled MacTaggart to return, ailing, to England in 1829, the 125-mile canal was finished within five years. In May, 1832, Col. By toured the full length of the newly-completed waterway. But his personal triumph was short-lived. A House of Commons committee at Westminster investigated charges that he had exceeded authorized estimates of expenditure on the project. He was exonerated but anxieties resulting from this cruel and unmerited inquiry doubtlessly helped to shorten By's life. He died in 1836 at the age of 53. Today this historic and scenic canal, although no longer used for the military purposes for which it was primarily designed, stands as a memorial to a man who directed what has been described as "the greatest work of British military engineers to be carried out in eastern North America".* No doubt the canal's initial utility and attractiveness helped to influence favorably Queen Victoria's choice in 1857 of Ottawa, formerly Bytown, as the seat of Canada's government. The settlement had won out over the rival claims of previous centres of government such as Montreal, Toronto, Quebec City and Kingston.

Twenty years after construction work began on the Rideau Canal, an Ottawa Provincial Land Surveyor, Robert Bell, headed a survey party that hewed its way toward the Muskoka River from Bytown. Montreal was then Canada's capital. Kingston had just been incorporated as a city, and Lord Elgin was newly-installed in office as Governor General. If one drew a line between Lake Simcoe across the province in the general direction of Montreal, there would be found, during the period 1820-50, four tiers of townships between that line and the water boundary to the south formed by Lake Ontario and the Upper St. Lawrence. This was a line that stood for a generation as a figurative, if not literal, barrier to economic development northward, while the mainstream of immigrants flowed into the far western parts of the province. Bell's project arose out of a change of government attitude towards more northerly settlement.

Bell was preceded in his monumental survey by Lieut. J. P. Catty, R.E., who in 1819 had made an exploratory survey from Lake Simcoe to the Ottawa River by way of the Madawaska, as well as by Lieut. Henry Briscoe, R.E., and Ensign Holland who surveyed in 1826 from Holland Landing to Fort Coulonge. In 1827 Lieut. Briscoe, Lieut. Greenwood and Lieut. Walpole completed these military examinations that were not so much designed to assess land resources as to find a practical water transport route for troops and supplies. In 1829 Alexander Sherriff, a civilian using maps drawn for him by Indians, journeyed from the Ottawa to the Muskoka River. Whereas reports of military surveyors had been unencouraging, Sheriff claimed, a trifle over-optimistically for his

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*Robert Legget in *Rideau Waterway* (p. 221); also "a masterpiece of early engineering".

time, the existence of "more than a million acres of fine, habitable land".

In any event the government of Upper Canada was beginning to show a constructive interest in the region and in 1835 this resulted in action. A survey party was launched, headed by Lieut. J. Cathew, R.N. and Lieut. F. H. Baddeley, R.E., assisted by a Mr. Hawkins, P.L.S., instructed to establish a base line running north through the centre of Muskoka and Parry Sound districts to reach Lake Nipissing. Explorations were also to be made of all large rivers flowing into Georgian Bay. The assignment was only partly completed as hardships experienced proved too severe. At one point the party nearly starved to death. Their reports disagreed with Sherriff's favorable conclusions.

But the tide of immigration continued to run strongly and pressure to open up more northerly areas in the province for settlement resulted in the active exploratory surveys of the mid-century era. One of the most important of these projects was headed by Robert Bell who later became a pioneer newspaper publisher, a railroad director and a member of parliament. He and his survey party left Bytown on August 9, 1847, and on August 25 had reached the Madawaska River. Bell started his survey line on the north bank of the river at a point determined by astronomical observations. Here his party divided, Bell surveying westward and John J. Haslett, P.L.S., travelling eastwards. Haslett had served his apprenticeship with Joseph S. Peterson, P.L.S. of Belleville, the man after whom the colonization road was to be named. On February 15, 1848, Bell completed his survey line about a half-mile beyond the junction of the north and south branches of the Muskoka River. On May 18 Bell and his party arrived back in Bytown. In 1850 Bell surveyed the route of the Ottawa-Opeongo colonization road. His line was not used as a road route, however, as the government favored the Peterson Road some 8 miles further south and running roughly parallel.

In 1849 Robert Bell became sole proprietor of a weekly publication in the Ottawa Valley known as *The Packet* and on February 22, 1851, changed its name to *The Citizen*. When Bell was elected to Parliament in 1861, representing Russell riding, he sold *The Citizen* to J. B. Taylor who published the first daily *Citizen* in 1865. During the 1850s Bell was also a director of the Bytown and Prescott Railroad, the first train of which reached Bytown on Christmas Day, 1854. In the following year Bytown became Ottawa, and the railroad was re-christened accordingly.

In 1854 John A. Snow, P.L.S., was instructed to survey the upper York River, a branch of the Madawaska, and its tributaries. This was the John Snow who, 15 years later, would prove to be a storm-centre in the serious troubles of the Red River Settlement. Yet Snow was a map maker of some talent and he drew very interesting maps in 1854 and 1855 which include the eastern parts of Haliburton county.

On November 8, 1852, William Lyon Mackenzie introduced in the Assembly a resolution asking for a survey of the Huron-Ottawa territory. There was a flurry of activity in road-building and in the surveying of the "back country" in 1857 and 1858. The Bobcaygeon Road and Peterson Road were pushed forward energetically and most of the outlines of three northern tiers of townships in Haliburton county were surveyed by Michael Deane, John Lindsay and J. W. Fitzgerald.

Early in 1859 a decision was made on the highest government level to open up the Huron-Ottawa country for settlement. This development was followed by another of major significance to the future of the area, the incorporation in 1861 in London, England, of The Canadian Land and Immigration Company. The date, April 15, coincided closely with the outbreak of the American Civil War, a conflict that was to have a considerable bearing on the fortunes of the newly-formed company. The story of this company and its settlement program, a corporate venture destined for liquidation some

28 years later, and of Alex Niven, a surveyor who was to play an important role in its affairs, is told in a subsequent chapter. It is sufficient to note here that the peopling of Haliburton region was influenced to a considerable extent by the survey and construction of at least four government-financed colonization roads, the Bobcaygeon, Peterson, Victoria and Burleigh Roads.

. J. W. Fitzgerald had been one of the several trained men active in the earliest surveying of the Peterborough area. John Huston was another. Under the official seal of Sir Peregrine Maitland a document declared that Huston had been found qualified in the art of surveying land and authorized to practice on October 28, 1820. In April, 1831, we find Huston surveying the road serving Hope, Cavan and Emily townships. Most of the original surveying in Peterborough district took place in 1861. Land closest to large lakes was surveyed first. In his diary of 1860 Fitzgerald the surveyor had some highly interesting observations to make of the Anstruther Lake country:

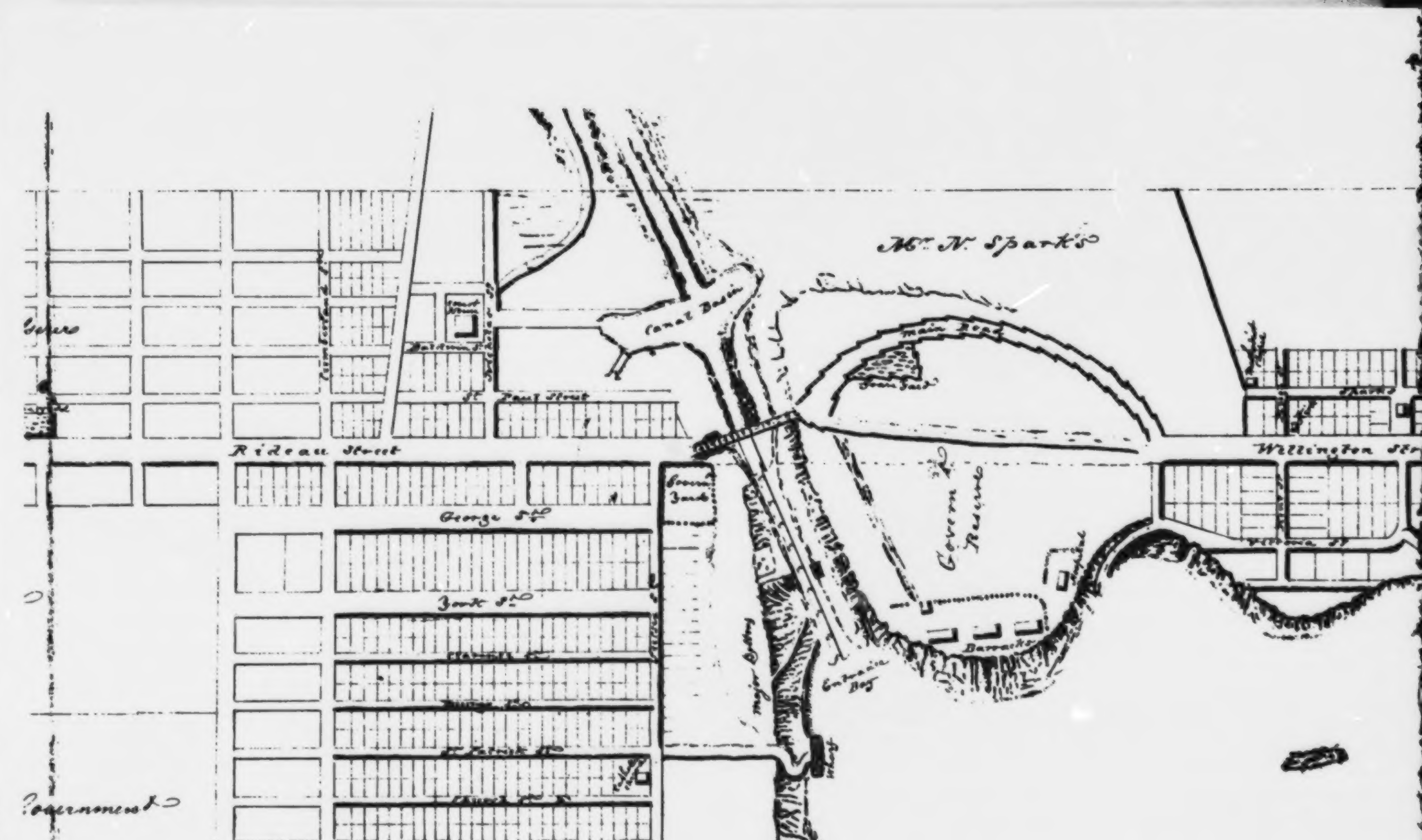
"In passing over a small creek, falling 30 feet from one lake into another, my attention was attracted to what on first sight appeared to be water flowing uphill. On closer examination I discovered swarms of suckers struggling up the current and so densely packed as to completely exclude the banks of the stream from sight. My next thought was to get some of the fish out. After many attempts and contrivances I jumped into the stream to catch them with my hands . . . In this way I and a few men threw out 500 pounds of fish . . . Suckers are capital eating towards the end of April when the water is yet cold".

The sale to the Crown of the Saugeen (Bruce) Peninsula by the Chippewa Indians in 1854 led, in the following year to an order for survey, on a rush basis, of the area involved in the transaction. It was necessary to act furiously fast in order to prepare the lands for settlement. The first lots, in fact, were put up for sale by public auction in the autumn of 1855.

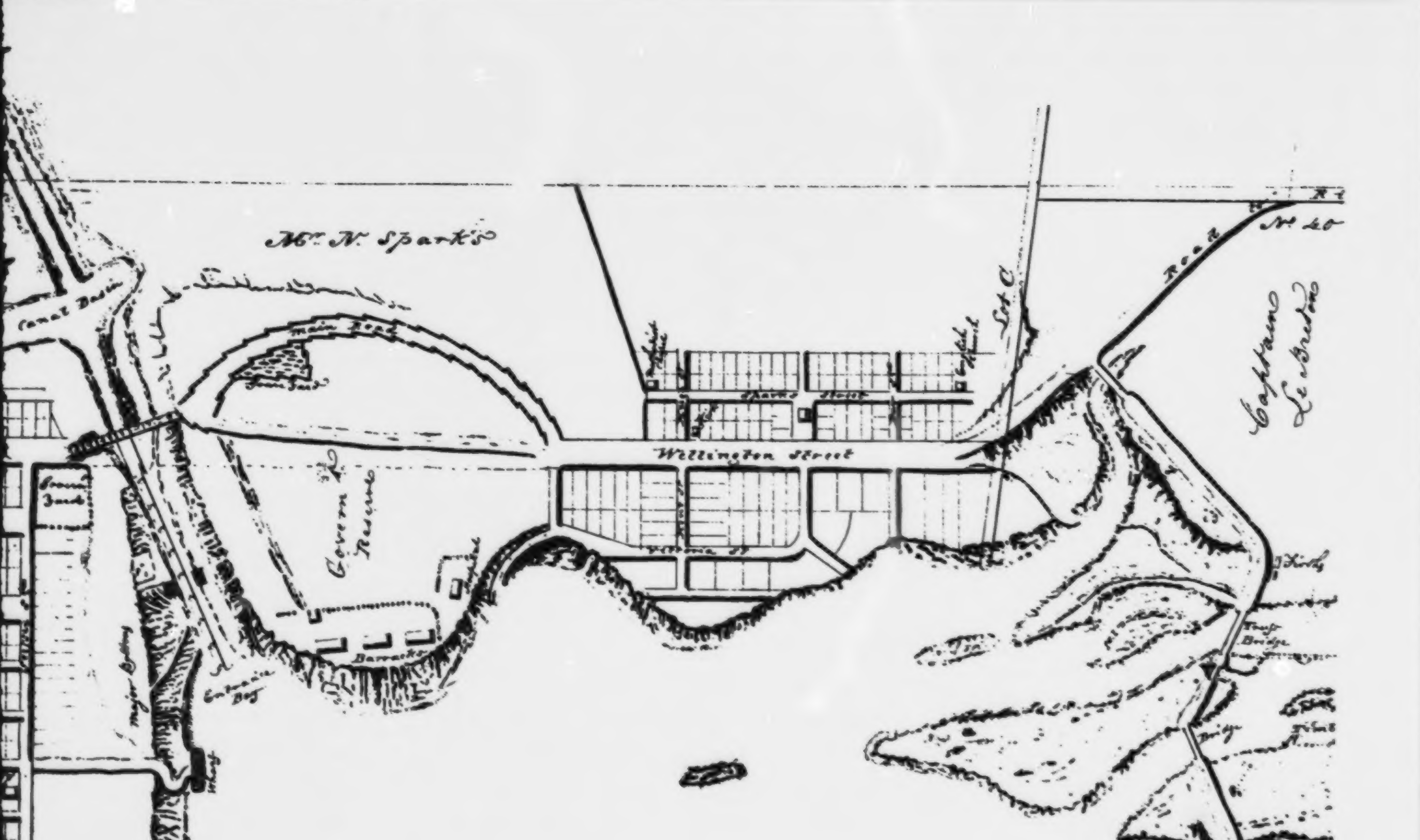
The men chosen for this emergency task were Charles Rankin, P.L.S. and John Stoughton Dennis, P.L.S. A year later in Toronto, John Stoughton Dennis, Jr., would be born. Father and son were to have a profound impact on the development of Canadian surveys generally in the years to come. The instructions issued to Rankin and Dennis came from the Indian Department in Quebec City, in March, 1855. The regular farm lots were to be made 20 chains in breadth by 50 chains in depth, of 100 acres each, with road allowances each one chain wide between each alternate concession and every fifth lot. "If your survey contains an eligible site for a town-plot, mark it on your plan, and report on its capabilities. You will keep a diary, in the form transmitted herewith, containing a detailed account of your proceedings; the number of chains surveyed each day, when you hired and when you discharged your men, and their names; the kind of weather, etc.".

Dennis, throughout these surveys, used a constant magnetic variation of 2 degrees, 34 minutes W. His instructions required him to traverse bodies of water in the townships of Albermarle, Eastnor, Lindsay, and St. Edmunds as well as the shores of Georgian Bay and of Lake Huron. In the mid-20th century surveyors who have had reason to retrace these 1855 survey lines are unimpressed by the quality of the work done. Field notes on this early project have been described as "inaccurate and unreliable". But it must be kept in mind that the 1855 surveys were carried out under the most difficult conditions and under very great pressure. And, as far as is known, no delays in settlement were experienced because of lack of preparatory surveying.

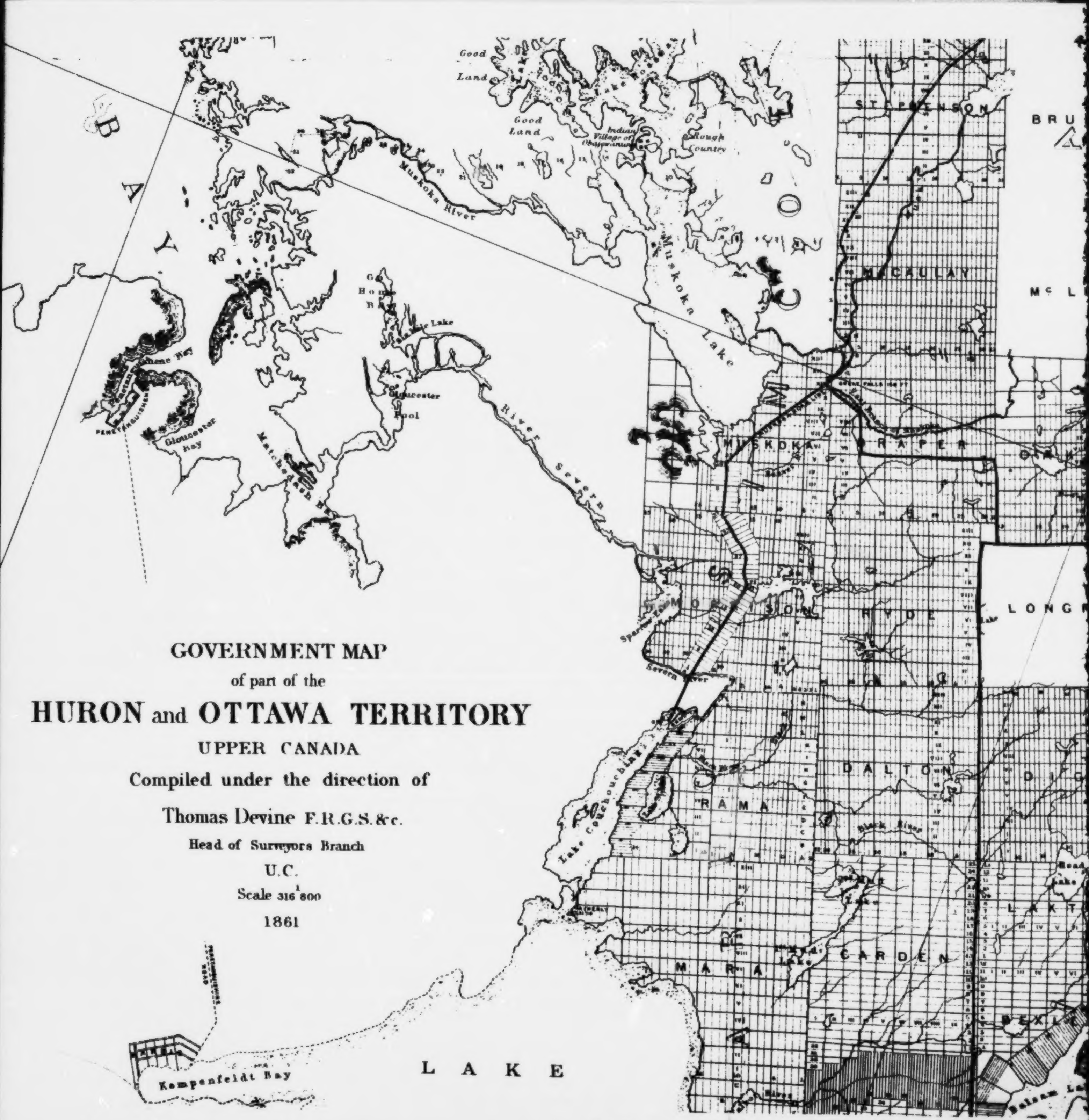
In the mid-19th century Upper Canada surveyors, although they might endure hardships in the field, managed generally to live comfortably in their city residences. The


Mr. N. Sparks
Canal Basin
Main Road
Rideau Street
St. Paul Street
Wellington Str
George St.
York St.
Govern Reserve
Barracks
Government
Ottawa River
Plan of BY TOWN
With some of the adjoining 200 acre Lo
Scale 3 chs 1 inch
10 acres of Lot 0
Lot 0
Mr. McKay's
New Edinburgh
Rideau Fall

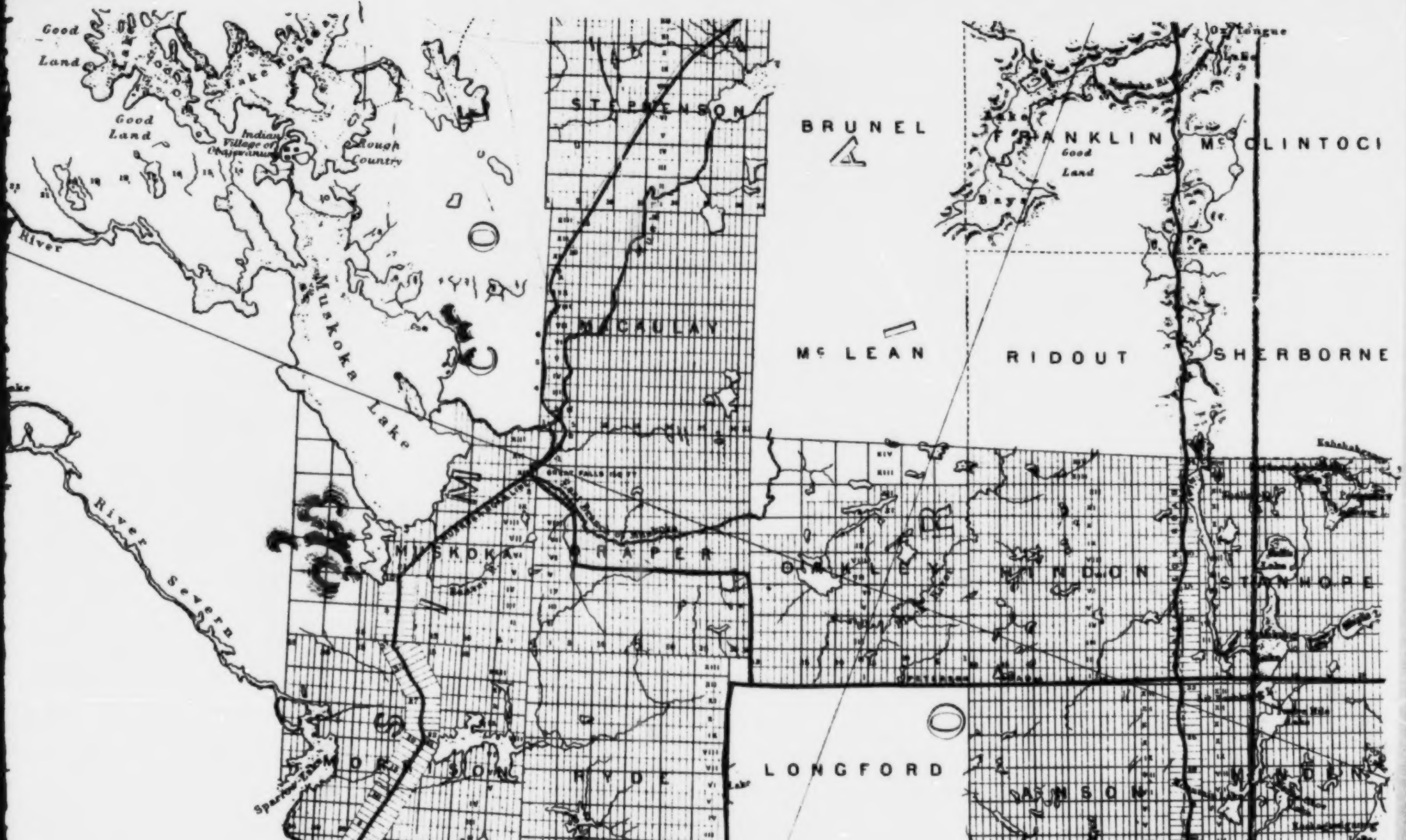
MAP 31. Plan of Bytown (Ottawa) by Anthony Swalwell, Deputy Prov. Surveyor, 1840. Courtesy of the Public Archives o


Mr. N. Spark's
Canal Basin
Main Road
Wellington Street
Sparks Street
Victoria St
Lot C
Road No. 40
Captain Le Breton
Govern.t Reserve
Barracks
Entrance Bay
Wharf
Truss Bridge
Union Bridge
Stone arches
Ottawa River
Plan of
BY TOWN
With some of the adjoining 200 acre Lot's.
Scale 3 chs 1 inch
Anthony Swalwell
Dep.y P.l Surveyor
Sep.r 4th 1840

f Bytown (Ottawa) by Anthony Swalwell, Deputy Prov. Surveyor, 1840. Courtesy of the Public Archives of Canada.


GOVERNMENT MAP
of part of the
HURON and OTTAWA TERRITORY
UPPER CANADA
Compiled under the direction of
Thomas Devine F.R.G.S.&c.
Head of Surveyors Branch
U.C.
Scale 316,800
1861
BAY
Good Land
Good Land
Indian Village of Obajewanung
Rough Country
Muskoka River
Muskoka Lake
Gloucester Bay
Gloucester Pool
River Severn
Severn River
Sparrow Lake
Lake Couchiching
Kempenfeldt Bay
LAKE
STEPHENSON
MACAULAY
MUSKOKA
DRAPER
MORRISON
RYDE
DALTON
RAMA
Black River
MARA
CARDEN
LONG
BRU
Mc L
LAKE
BEXL
Balsam L

MAP 32. Courtesy of the Public Archives of Canada.


Good Land
Good Land
Indian Village of Obajewanung
Rough Country
River
Muskoka Lake
River Severn
STEPHENSON
BRUNEL
Oxtongue
FRANKLIN
Good Land
McCLINTOC
MACAULAY
McLEAN
RIDOUT
SHERBORNE
MUSKOKA
DRAPER
OAKLEY
HINDON
STANHOPE
MORRISON
Sparrow Lake
Severn River
RYDE
LONGFORD
ANSON
MINDEN
ITORY
DALTON
DIGBY
LUTTERWORTH
SNOWDO
RAMA
Lake Couchiching
Black River
Head Lake
LAXTON
MARA
CARDEN
BEXLEY
SOMERVILLE
GALWAY
Balsam Lake
A K E

MAP 32. Courtesy of the Public Archives of Canada.

Gibson House in Willowdale, located on part of Lot 18, first concession west of Yonge Street, Toronto, is considered representative of the times and of the profession. It was the home of David Gibson, P.L.S., and was built in the 1840s. From this edifice it is evident that the surveyor of that period was a man of means and social position. It is now preserved as a historical site of some importance and an authentic example of the progress of Canadian housebuilding from the pioneer's log cabin to the modern split-level home.

16

INTERNATIONAL BOUNDARY SURVEYS

"Come here's the map—shall we divide our right . . . ?"
Henry IV (1), Act 3, Sc. 1.

Through the ages man has devoted considerable time and effort to the task of drawing lines calculated to divide up his locality or his world in one form or another. In more modern times he has established grids of lines around the earth by means of which he may more accurately fix points on the earth's surface. Nations, like individuals, have drawn boundary lines to mark off their territories from those of other nations and by manning these borders, warn off trespassing forces. Violations of private property have culminated, all too often, in litigation and violations of national frontiers in wars. With nations, as with individuals, validly founded and physically durable boundary lines, the work of surveyors and mappers, are indispensable to harmonious relationships.

The most satisfactory and most permanent boundaries are those that, in the main, follow well-defined geographic features; are readily recognizable and where residents on both sides of the line are reasonably well reconciled to its presence. The Canada-United States boundary derives its durability not from its connection with definite geographic features but because, on the whole, Canadians and Americans are agreed over its validity.

International boundaries, in their very nature, are the result of compromises, often of the reconciliation of strongly opposing views. Canada and the United States, during the years their territories were taking shape, came close on several occasions to open warfare over boundary differences. Whenever compacts, after due deliberation, were concluded there has been a tendency on both sides to forget feelings of animosity and to live peaceably with the decision. Cooperation across borders has been increasingly cultivated by the people of North America, rather than any nursing of grudges over lands lost through treaties and other settlements.

The road to enlightened agreement was, on occasion, very rough and fraught with grievous dangers to the peace. On at least three separate occasions clouds hung low over the international horizon as a result of stormy disagreements during which patriotic passions ran high on both sides. In some instances European monarchs were asked to arbitrate outstanding boundary line differences. The position of the Canada-United States boundary achieved at the mid-20th century is the result of nine formal treaties, those of 1783, 1794, 1814, 1842, 1846, 1871, 1908, 1910, and 1925; of five international conventions (1818, 1827, 1892, 1903 and 1906) as well as of a number of exchanges of diplomatic notes.

Canadians and Americans share one of the longest land-water boundaries in the world. Its 5,525.1 miles represent nearly one-quarter of the earth's circumference at the equator. The border between the two countries consists of a series of straight lines, courses of which vary in length from 23¼ inches in the Quebec-Maine highlands to 647 miles of the 141st meridian. The latter course is probably the longest surveyed straight-line international boundary in existence.

The Canada-United States boundary extends from the Bay of Fundy in the Atlantic across the continent to the Pacific by way of the Straits of Georgia and Juan de Fuca (3,986.8 miles) and from Dixon Entrance to Mount St. Elias, thence along the 141st meridian to the Arctic Ocean (1,538.3 miles). More than 125 years of negotiations, arbitrations and treaty-making have been required to establish this boundary to date. From 1783 onwards the work of surveyors and mappers has been essential to the conclusion of agreements worked out by statesmen. This chapter is devoted to an assessment of the value of Canadian surveys and maps to boundary-line bargaining processes and to the settlement of sometimes acrimonious disputes extending from the last part of the 18th century to the time of Confederation.

Unlike the development of borders of European nations the Canada-United States boundary, to a large extent, was drawn on paper in the first instance and then traced on the ground. The early treaty-makers depended mainly upon certain prominent physical features, upon historical usage and geographical coordinates of latitudes and longitudes.

The source of greatest friction over the boundary was ignorance of treaty-makers of the land on which border lines were being imposed. If the statesmen concerned had had the opportunity to view the lines on the ground, rather than drawn on paper, much trouble could have been averted. The framers of the 1783 treaty (Versailles) in selecting the St. Croix River as the international boundary leading inland from the Bay of Fundy, failed to realize that the name "St. Croix" had long ago become obsolete and that even experts in the geography of the region disagreed over the identity of the river to which that name once applied. Similarly on the Pacific Coast the treaty drafters provided that the international boundary should follow "the middle of the channel separating Vancouver's Island from the continent . . ." not realizing that, in fact, there were several channels answering that description.

Those responsible for the various Canada-United States boundary line treaties and conventions were undoubtedly influenced in varying degrees by the claims and disputes arising out of the earliest discoveries in and around the North American continent. There were, for example, conflicting descriptions of the territory of Acadia. In 1638 the King of France awarded the province of Nova Scotia as Acadia to La Tour. Yet 10 years later when Charnisay was made governor of Acadia that area is described not as the peninsula country but all the land from Virginia to the south shore of the St. Lawrence. This uncertainty over the precise bounds of Acadia persisted over the years. Border disputes arose all too readily over the interpretation of treaty terms in which such vagueness was repeated.

One principal ironic condition applied to all these boundary claims and counter-claims. Britain, when opposing New France from the base of her American colonies, persisted in claims that her territories extended northward to the St. Lawrence itself. Throughout the period of the Treaty of Utrecht (1713-63) Britain considered Acadia and Nova Scotia to extend to the St. Lawrence and maps of that time clearly reflected that belief. But after the capture of Canada and the revolt of the American colonies Britain found it necessary to reverse her previous attitude in boundary arguments and to advocate a Quebec border extending as far to the south as possible.

In practically all the boundary-line surveys conducted on behalf of Canada during the 19th century the British Royal Engineers played an important part. The names of Hawkins, Pipon, Ward, Anderson and others are prominent in the reports of these highly important surveying and mapping activities. But even before the coming to Canada of the first Royal Engineers as land surveyors, certain pioneer boundary measurements had been made.

In 1738, for example, there had been a tentative exchange of letters between the Surveyor General of New York and the Governor of Nova Scotia in which the former urged the British to resist boundary violations by the French. Again, in 1766, Governor Moore of New York suggested to Governor Murray at Quebec that it would be well to locate definitely the 45th parallel. He suggested a joint meeting at the junction of the Richelieu River with the St. Lawrence. In the absence of Governor Murray in England, Lieut.-Governor Guy Carleton kept this appointment, taking with him John Collins, the Deputy Surveyor General. In the surveys that followed, each surveyor working independently of the other, it was discovered that the New York representative had placed his boundary line farther south than had Collins. It was agreed to accept the Collins line. An Order in Council of August 12, 1768, confirmed this line and ordered its extension eastward to the Connecticut River. But it was 1771 before this survey was undertaken. John Collins met Joseph Smith of New York on the shores of Lake Champlain. Before harsh winter weather stalled them the line had been surveyed for 22 miles. Bills for "sundrys" on this survey included items such as "rum and wine (£10 7s 4d); six gallons of French brandy (£2 8s); and Paid to the Cooper for Kegs and drawing off a Cask of Wine at Quebec (£1 1s 7d)". All in all, it is surprising that the line they surveyed was so straight!

In 1771-72 the Governor of Quebec, evidently unaware of the rigors of the continental winter climate, insisted on pushing ahead in March with these boundary surveys. The New York Surveyor General demurred on the grounds that his chronic gout would be aggravated "which would not only Retard the Service but would endanger my life". Accordingly Thomas Valentine (sometimes Vallentine) was chosen as a substitute for the sagacious, if painfully stricken, Surveyor General. His instructions were to run the line with care. Valentine was to "blaze the Trees on the East and west Sides as you pass along, Cuting down only such Trees as stand directly in the sight of the Compass, and at the Distance of every 3 miles lying together in large heaps of stones and cutting a few Knotches on the Trees nighest each pile of Stones".[1]

This eastward-moving survey was completed in September, 1772, and the result of these labors came to be known as the Valentine-Collins Line. When the survey parties reached the Connecticut River they were disturbed by Abenaki Indians who "were much displeased", claiming their hunting grounds were being encroached upon. The anger of the savages with Valentine and Collins took a more positive form when the Abenakis "pull'd down a Post that had been erected on the east bank of Lake Memphremagog". This incident, though a minor one, was a dire portent of a future replete with displays of Indian resistance to the white man's surveys, culminating in Canada in the Red River troubles of 1870 and the prairie uprising of 1885.

During the 1773 survey season a substitute for Valentine had to be found as the New Yorker came down with "a Billious complaint, attended with a Choke in my Bowels . . . ". It was decided, however, that the boundary line work could not wait upon a cure for constipation any more than on the convolutions of governments. Accordingly a surveyor named Saulthier became the New York representative in running the line westward from Lake Champlain. Collins, apparently fearful that Saulthier might develop sickness on the job, offered to run the line himself the remainder of the distance for £100. Governor Tryon of New York, satisfied with Collins' integrity, agreed. Thus, by 1774, the surveyed boundary line stretched from the Connecticut River to the St. Lawrence River.

Protracted peace negotiations were held at Paris during 1782, leading to the treaty between Great Britain and the United States in the following year, and although the extent of its territory was being decided Canada itself was not directly represented in the discussion. To British leaders of that day Canada remained a sort of unresolved North American riddle. Lord Shelburne, the British prime minister at the time, was not noted for his concern over British North America and his chief negotiator at the peace conference, Richard Oswald, a weak and vacillating diplomat, appeared content to liquidate on any terms what he considered to be a disastrous imperial investment. None of the British negotiators were a match for the Philadelphia printer (Benjamin Franklin), the New York aristocrat (John Jay) or the Boston lawyer (John Adams) who represented the American case.

Franklin at the outset sought all of Canada for the new republic. Oswald thought well enough of this bold proposition to recommend it to Shelburne who at first was inclined to approve the idea. But on reflection the prime minister became convinced that Britain could not thus abandon Nova Scotia and the Halifax naval base. Accordingly the emphasis in the talks shifted to boundaries. Although the negotiators at Paris knew little about the course of the St. Croix River the Americans pressed for the international border along that watercourse. They also advocated that beyond the unmapped river the boundary line ought to proceed directly north to the St. Lawrence River. In this daring effort to sever land communications between the province of Quebec and the Maritime settlements the astute and aggressive American delegates failed.

Gradually the British attitude at the conference stiffened in regard to American demands. Article Two of the treaty, signed on September 3, 1783, reflected this change of heart. It was provided that the boundary would run from the so-called North West Angle of Nova Scotia to the highlands ". . . which divided rivers emptying into the St. Lawrence from those which fall into the Atlantic, to the Northwesternmost head of the Connecticut River, then along that river to the 45th degree of North latitude." From that point the line was to run due west until it met the St. Lawrence River (then known as the Iroquois or Cataraquy) then up the middle of that river to Lake Ontario, through the middle of the Great Lakes "northward of Isles Royale and Phelipeaux to the Long Lake . . . to the most Northwestern Point of the Lake of the Woods . . . and from thence on a due West course to the Mississippi River . . .".

The wording of the first part of Article Two of the treaty followed closely that of the Royal Proclamation of 1763 creating the province of Quebec and of the 1774 Quebec Act as well as the commission given by the Crown to Governor Wilmot of Nova Scotia in 1763. So sparse was the information available to the 1783 treaty makers that they supposed the source of the Mississippi was far enough north so that a line running due west from the North West Angle of the Lake of the Woods would intersect that river.

The 1755 Mitchell map of North America, on which the negotiators confidently relied, failed to delineate the source of the Mississippi but carried the footnote: "The head of the Mississippi is not yet known. It is supposed to arise about the 50th degree of latitude". Possibly this was an educated guess for those times but nevertheless the estimate was about 150 miles in error. David Thompson in 1798 found the head of that river to be at 47 degrees 38 minutes north latitude.

Not long after ratification by both sides of the 1783 treaty it became obvious that surveys of the boundary line on the ground would be delayed by a variety of interpretations of such points as the true location of the "St. Croix River", the whereabouts of the "North West Angle of Nova Scotia", of the "Northwesternmost head of the Connecticut River" and the nature and location of the "highlands"—all mentioned in Article Two. Actually arguments over issues such as these continued for a half-century to come. Even at the time of the Treaty of Ghent (1814) controversy was in its early stages only. When reports began to circulate concerning the unusual fertility of land near headwaters of the Connecticut River, pressures for the solution of these lingering problems began to mount. By 1820 about 50 families of Americans were settled near Indian Stream in what is now New Hampshire. Soon the boundary line question in that vicinity was to develop into a lively, not to say explosive, issue.

Thirteen years passed before the first point of controversy was settled. As there was no river known as the St. Croix during the latter part of the 18th century Nova Scotians claimed that the Cobscook or the Scoodic (sometimes spelled Schoodic) was the river intended to form the international boundary. Americans claimed that the Magaguadavic was, in fact, the boundary river. With the passing of years and the appearance of Loyalist settlements at St. Andrews and St. Stephen the matter was becoming more urgent. Finally, after considerable haggling Jay's Treaty (as it came to be known) of 1794 was signed providing for the appointment of a commission to settle the issue. David Howell was the United States commissioner and Thomas Barclay (1753-1830) of Annapolis, the British commissioner. As Barclay served on several succeeding boundary commissions it is interesting to note that he studied law under John Jay, after attending King's College, New York (now Columbia University). He served with the Loyal American Regiment during the Revolution, attaining the rank of major in 1777. In Nova Scotia, as a Loyalist immigrant, he was elected to the House of Assembly in 1785, becoming its Speaker in 1793.[2]

In 1796 at the first meeting of the commissioners in Halifax, a third commissioner, Egbert Benson of New York, was appointed. James Sullivan was United States agent and Ward Chipman, Solicitor General of New Brunswick, was British agent for the commission. These agents were instructed to have surveys made of the rivers claimed by the opposing sides to be the St. Croix. The surveys were carried out from 1796 through to the end of the 1797 season, resulting in very detailed, accurate maps. Copies of the original surveyors' journals and field notes have been preserved. The survey of the Magaguadavic commenced in October, 1796, by Isaac Hedden, a skilled surveyor employed by the New Brunswick Crown Land Office. John Peters of Maine was the United States representative. The following year, when Hedden's health was poor, Dugald Campbell was appointed in his place. Campbell and Peters, working in the greatest harmony, completed the joint survey in 1797, supplemented by work of another American surveyor, Samuel Titcomb. Maps in Campbell's field book are on the scale of 20 chains to the inch, or 4 inches to the mile, and are beautifully drawn.[3] Results of all the surveys were assembled and compiled in a general map in 1798 by Surveyor General George Sproule of New Brunswick. This map became basic to all subsequent cartography of the rivers surveyed.

Some extracts from the journal of John Peters on the Hedden-Peters surveys of 1796 are enlightening:

"Saturday, October 1: Begin our survey at a point mentioned in our instructions in company with Mr. Hedden and mark two birch trees *1796* and run 187 Rods this day".

"Sunday, October 2: Employed this morning in storing provisions at the Falls and pitching the Tent".

"Thursday, November 3: This day Snow. . . ."

"Friday, November 4: The snow remaining, could not continue the Survey, conclude to return home. . . ."

From the journal written by Dugald Campbell in 1797 we learn:

"Thursday, June 29: In the morning after a still night we observed that the surface of this considerable Lake we have called Loon Lake was generally covered with a yellow scum mixed with flies which gave the water an intolerable bad smell than which nothing could be more offensive, and yet we were obliged to drink of it, as we could not find a spring of water any where around the lake".

"Friday, August 25: having now compleated [sic] the Survey of all the upper branches of the River Magagawdavic [sic] the time arrived at last, for us to take our leave of those woods, which we certainly did without any regret, believing that it is but seldom any party on a similar occasion has undergone greater fatigue. When we undertook this survey we well knew that it would necessarily be attended with a great deal of toil and although in this respect it has far exceeded our expectations, if we are so happy as to merit the approbation of the Agents of His Britannic Majesty and the United States of America under whose instructions we acted, we shall think our pains well bestowed. . . ."

Finally, in September, 1798, following consideration of the survey reports and after listening to opposing arguments, the commission decided that the Scoodic was in fact the historical St. Croix River, described by Champlain.[4] A verifying factor was Ward Chipman's timely excavation of relics of an ancient settlement on Dochet Island in the Scoodic.

By Article Five of the Treaty of Ghent it had been provided that as the North West Angle of Nova Scotia had not been determined nor any part of the international boundary between the source of the St. Croix and the St. Lawrence surveyed or marked, two commissioners should be appointed to determine this line in accordance with the 1783 treaty, and to submit a properly certified map thereof. Once again Thomas Barclay was made British commissioner and Cornelius Van Ness the United States commissioner. Ward Chipman, aided by his son Ward, was appointed British agent and William C. Bradley, United States agent. This commission met at St. Andrews in September, 1816 and in June, 1817 in Boston decided to institute surveys. Accordingly in the seasons of 1817-18-19 a large number of surveys were carried out. In addition, Dr. J. C. Tiarks, a British astronomer, made a new determination of latitude where the old Valentine-Collins line intersected the Connecticut River. Observations made by Tiarks and F. R. Hassler, first Superintendent of the United States Coast and Geodetic Survey (formed in 1807) revealed that the original determination of the 45th parallel as made in 1766 was three-quarters of a mile too far north.[5]

The T. Barclay-J. Holmes commission was entrusted under the terms of Article Four of the Treaty of Ghent with the task of examining and, if possible, deciding finally upon the course of the boundary from the mouth of the St. Croix, through the islands of Passamaquoddy Bay, to the Bay of Fundy. Article Two of the 1783 treaty in part declared ". . . comprehending all islands within 20 leagues of any part of the shores of the United States and lying between lines to be drawn due east from the points where the

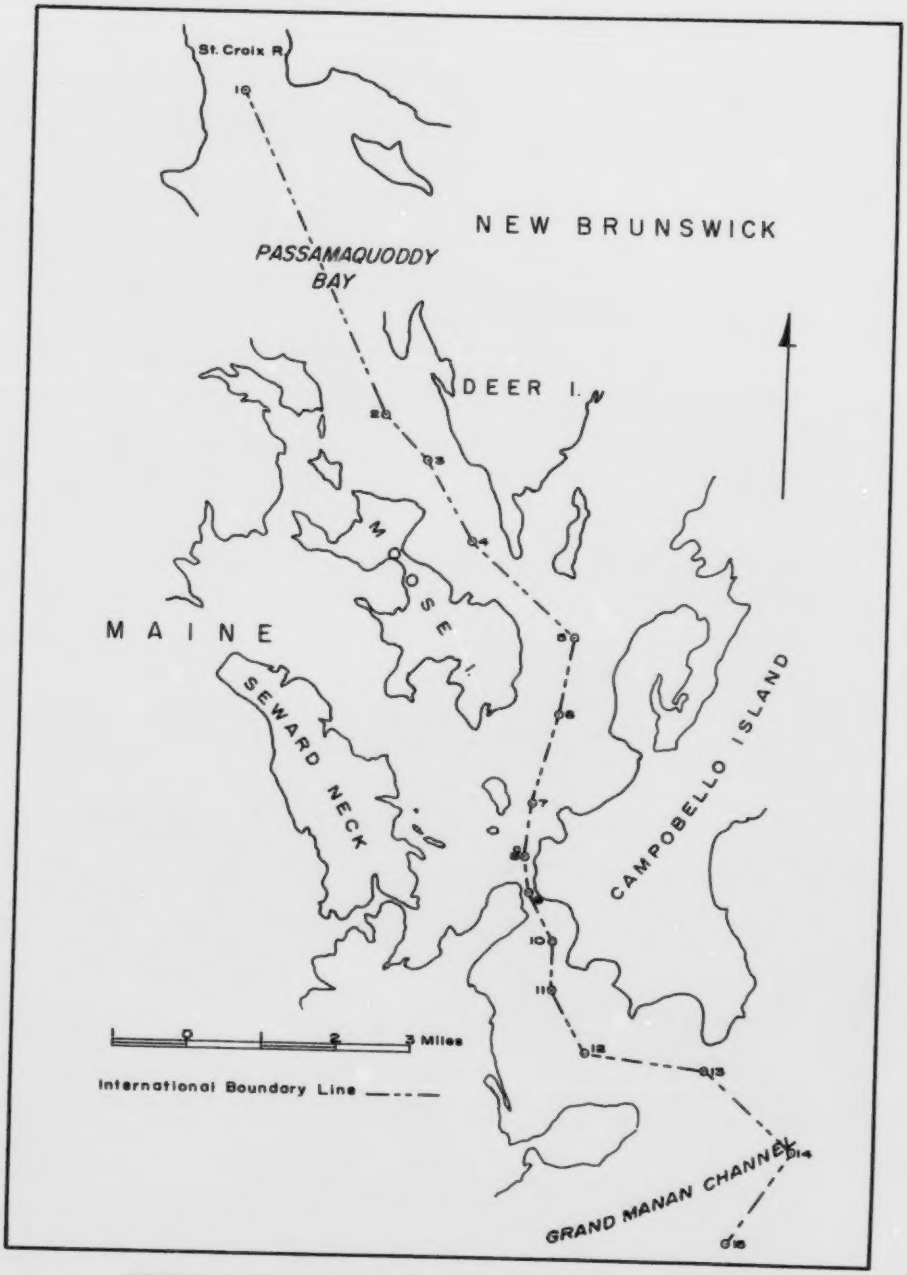

St. Croix R.
1
NEW BRUNSWICK
PASSAMAQUODDY BAY
DEER I.
2
3
4
MOOSE I.
MAINE
5
SEWARD NECK
6
CAMPOBELLO ISLAND
7
8
9
10
11
0 1 2 3 Miles
International Boundary Line
12
13
14
GRAND MANAN CHANNEL
15

FIGURE 33. International Boundary Line in Passamaquoddy Bay, New Brunswick.

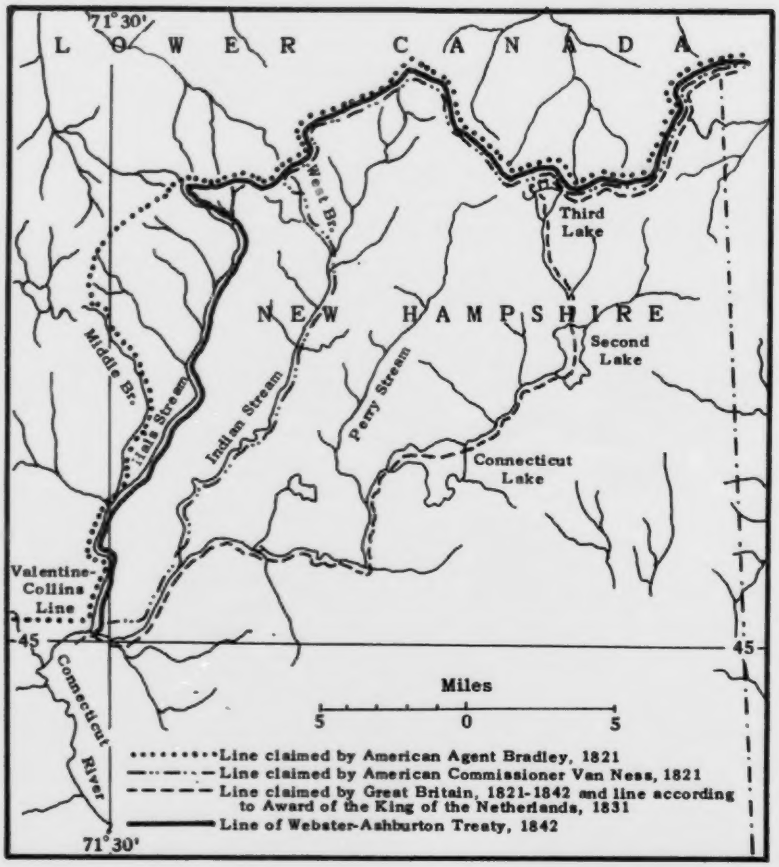

71°30'
L O W E R C A N A D A
West Br.
Third Lake
N E W H A M P S H I R E
Second Lake
Middle Br.
Halls Stream
Indian Stream
Perry Stream
Connecticut Lake
Valentine-Collins Line
45
45
Connecticut River
Miles
5 0 5
Line claimed by American Agent Bradley, 1821
Line claimed by American Commissioner Van Ness, 1821
Line claimed by Great Britain, 1821-1842 and line according to Award of the King of the Netherlands, 1831
Line of Webster-Ashburton Treaty, 1842
71°30'

FIGURE 34. Certain proposed Lower Canada-United States boundary lines and the final (1842) treaty line, showing relationship to Indian Stream Territory, New Hampshire, and the northwesternmost head of the Connecticut River. (After Albert B. Corey, *The Crisis of 1830-42 in Canadian-American Relations*. The Ryerson Press, 1941 and courtesy of Carnegie Endowment for International Peace.)

[aforesaid] boundaries between Nova Scotia on the one part . . . East Florida on the other, shall respectively touch the Bay of Fundy . . . excepting such islands as now are, or heretofore have been, within the limits of the said Province of Nova Scotia".

On a modern map it will be observed readily that Grand Manan Island and, in fact, nearly all the islands in Passamaquoddy Bay lie south of a line drawn due east from the mouth of the St. Croix and within 20 leagues of the United States. Thus these islands would belong to the United States except for that saving final clause in Article Two.

Previous to the 1783 treaty Nova Scotia did exercise jurisdiction over some of these islands. The United States, however, claimed Moose, Dudley and Frederick islands. In any case a final decision on the distribution of the Bay islands rested on the identification of the St. Croix River. Following the meetings of 1816 and 1817 a decision was reached on November 24, 1817, by the commissioners Barclay and Holmes that Moose, Dudley and Frederick islands belonged to the United States and all other islands in Passamaquoddy Bay, including Grand Menan (Manan) and Campobello belonged to Great Britain. No precise surveys of the boundary line in the Bay were undertaken by either nation until 1893.[6]

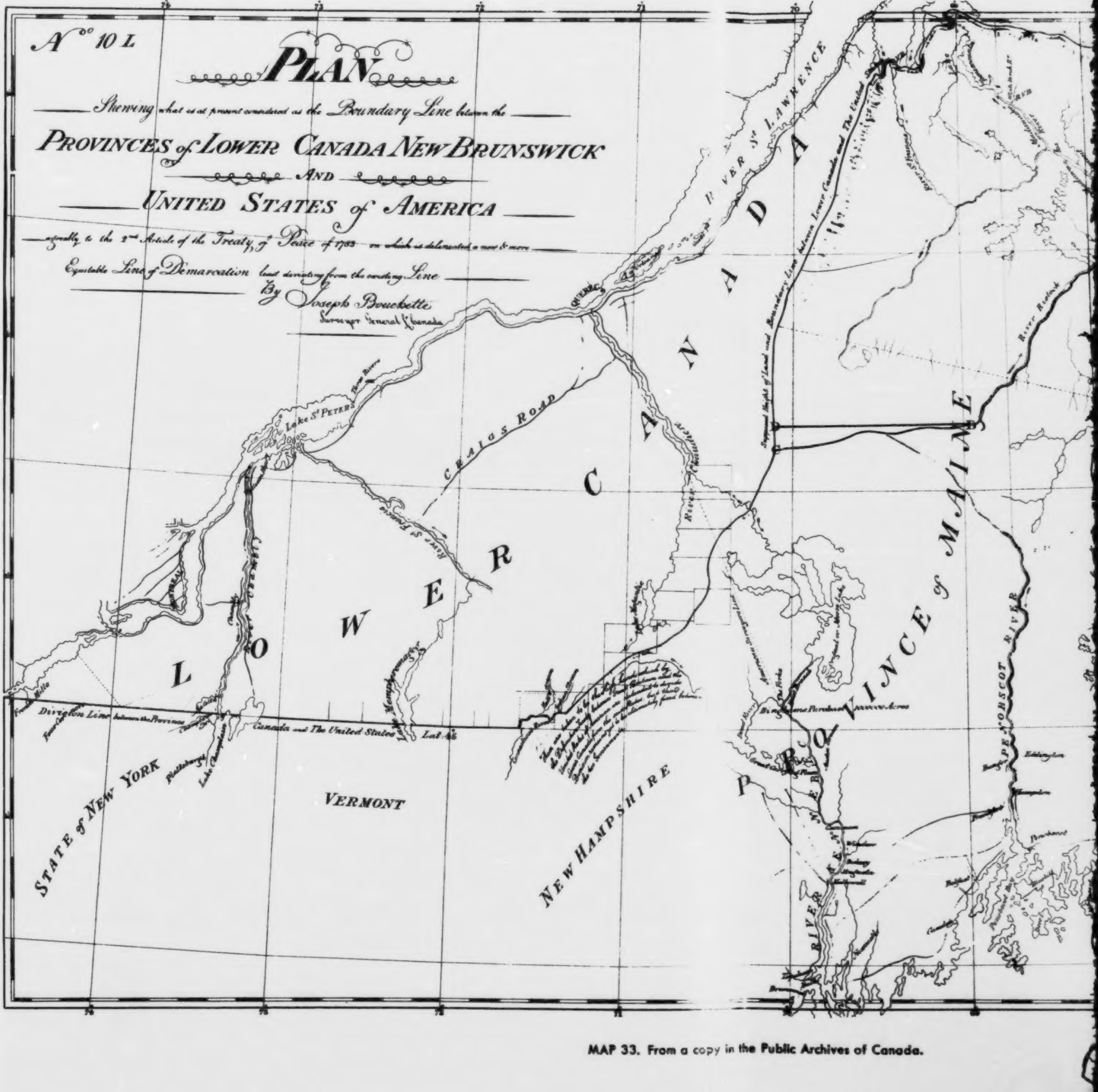
The surveyors appointed to run the international boundary line north from the sources of the St. Croix were, for Great Britain, Col. J. Bouchette, Surveyor General of Lower Canada, and for the United States, John Johnson. Mr. Odell, another British representative, acted on a related exploring line survey. In the summer of 1821 opposing arguments were heard, after which the commissioners delivered their opinions in notes to each other. They failed to agree and reports were then made by them to their respective governments. Under the terms of the Treaty of Ghent the King of the Netherlands was asked to act as arbitrator. It is interesting to note that during the arbitration proceedings only the 1755 Mitchell map and one other (Map A) were permitted to be used as official maps. In 1830 the King rendered his decision which favored the establishment of a conventional, rather than a treaty boundary line. Massachusetts and Maine protested vigorously and the United States Senate accordingly rejected the award.

It was after the rejection of the award that Canada and the State of New Hampshire both began to assert authority over the Indian Stream country in which some 50 families had settled. Canadians regarded the area as their Lower Canada township of Drayton. Controversy arose out of uncertainty over what stream was, in fact, "the Northwesternmost head of the Connecticut River" and therefore the international boundary watercourse. Between the more northerly-running Hall's Stream, regarded by Americans as best fitting the treaty description, and Indian Stream, representing the British claim, an area of some 150 square miles became the scene of jurisdictional disputes between the two national authorities.

Early in 1835, following a number of disturbing border area incidents, a sharp exchange of official views took place through diplomatic channels, correspondence involving the Governor General of Canada (Lord Aylmer), Sir Charles Vaughan, British Minister to Washington, and the U.S. State Department.[7] The British and Americans vigorously protested over the arrests of their nationals within the disputed region. In June, 1835, the New Hampshire legislature declared in a formal resolution that the state "should continue the possession of Indian Stream territory" until the boundary dispute was settled. Governor William Badger ordered the 24th Regiment of New Hampshire to proceed to the territory. During that tense summer war clouds hung ominously on the horizon but vanished suddenly when British assurances of restraint were offered pending a final disposition of the boundary line question.

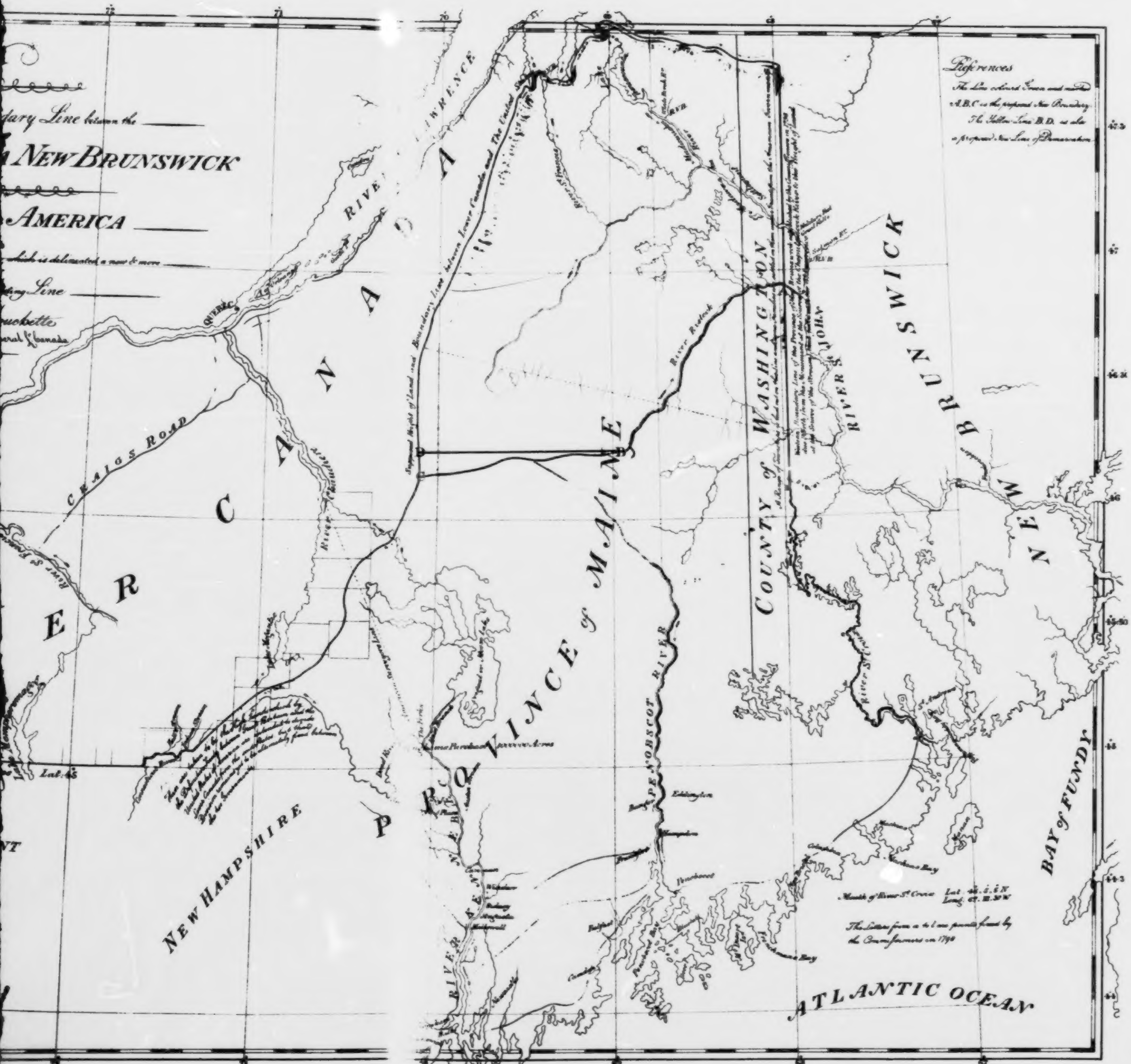
Again, on February 12, 1839, men from New Brunswick, after a series of border incidents, surrounded a civilian force of 500 from Maine at the mouth of the Little Madawaska. They arrested three Americans and took them to Fredericton in custody. The following day the Lieutenant Governor of New Brunswick, Sir John Harvey, issued what seemed to the people of Maine a proclamation tantamount to a declaration of war. Troop movements began on both sides. President Van Buren despatched General Winfield Scott to restore stability in the area. A truce was arranged on the basis that New Brunswick would control the Madawaska region to the north and Maine the Aroostook country to the south, pending a decision on the boundary line in dispute.[8]

In 1841 Daniel Webster, born in New Hampshire, and newly-appointed U.S. Secretary of State, proposed to the British government that the boundary line ought to be settled by direct negotiation. Great Britain agreed and appointed Lord Ashburton as its rep-



N° 10 L
PLAN
Shewing what is at present considered as the Boundary Line between the
PROVINCES of LOWER CANADA NEW BRUNSWICK
AND
UNITED STATES of AMERICA
agreeably to the 2nd Article of the Treaty of Peace of 1783 on which is delineated a new & more
Equitable Line of Demarcation least deviating from the existing Line
By Joseph Bouchette
Surveyor General of Canada
LOWER CANADA
RIVER St LAWRENCE
QUEBEC
Three Rivers
Lake St PETERS
CRAIGS ROAD
Division Line between the Province Canada and The United States Lat. 45
STATE of NEW YORK
VERMONT
NEW HAMPSHIRE
PROVINCE of MAINE
PENOBSCOT RIVER
KENNEBEC RIVER
Lake Champlain
Plattsburgh

MAP 33. From a copy in the Public Archives of Canada.


NEW BRUNSWICK
AMERICA
Line
CANADA
RIVER ST. LAWRENCE
QUEBEC
CRAIGS ROAD
PROVINCE of MAINE
COUNTY of WASHINGTON
NEW BRUNSWICK
RIVER ST. JOHN
PENOBSCOT RIVER
RIVER KENNEBECK
NEW HAMPSHIRE
ATLANTIC OCEAN
BAY of FUNDY
References
The Line coloured Green and marked A.B.C is the proposed New Boundary.
The Yellow Line B.D. is also a proposed New Line of Demarcation
Mouth of River St. Croix
Lat: 45

MAP 33. From a copy in th blic Archives of Canada.

resentative. Proceedings opened in Washington, D.C. in April, 1842. By a treaty signed there on August 9, 1842, a settlement was finally achieved. Maine and Massachusetts consented although this treaty gave the United States nearly 1,000 square miles less than the rejected award of the King of the Netherlands! Maine was made a less unwilling participant by a promise of the United States government to pay all expenses incurred by Maine in the bloodless border war and to make a grant of $150,000 in place of land yielded to Canada on the St. John River. Both Webster and Ashburton were strongly criticized for unduly sacrificing the interests of the countries they represented. In some British and Canadian quarters the treaty was described as "Ashburton's Capitulation". The agreement gave seven-twelfths of the disputed area to the United States but Canada retained the strategically important ridge of the highlands commanding the valley of the St. Lawrence River.

Under Article One of the Webster-Ashburton Treaty the boundary line was to run "to the head of Hall's Stream, thence down the middle of said stream, till the line thus run intersects the old line of boundary surveyed and marked by Valentine and Collins, previously to the year 1774, as the 45th degree of north latitude. . . .". In accordance with this 1842 treaty two commissioners were appointed to survey and mark the boundary from the source of the St. Croix River to the St. Lawrence River. Lieut.-Colonel J. B. B. Estcourt was named by Great Britain and Albert Smith by the United States. Estcourt (1802-55) of the 43rd Regiment of Light Infantry, had been made a Lieut.-Colonel in 1839. A member of the British parliament for a term, Estcourt was made a major-general in 1854 and died of cholera in the following year. Assisting him on these surveys were Capts. Broughton and Robinson and Lieut. Pipon, R.E., as well as Messrs. Featherstonaugh, Wilkinson and Scott, in addition to a number of non-commissioned officers of the Royal Sappers and Miners. First meeting of the commissioners took place at Bangor, Maine, on May 1, 1843. On June 1st field work began.

The Valentine-Collins line was found by the original tree blazes. By counting the rings in trees it was calculated that the marks dated back to 1772, 1773 and 1774. Iron monuments were erected. At Rouses Point, however, a stone monument was established on the boundary in the meridian as determined by the transit instrument used by Major Graham, chief astronomer of the United States commission. Maps drawn as a result of these surveys included 62 sheets compiled by the British on a scale of 4 inches to a mile, and 61 by the Americans. A general map was also made by the British on a scale of 8 miles to one inch and by the Americans on a scale of 10 miles to one inch.[9]

At several points along the highlands boundary astronomical observations were made to control guide lines of the survey in this region. The longitude of Rouses Point was determined by the interchange of chronometers, and independently by lunar observations. Other boundary stations were directly connected with Rouses Point by observations made of gunpowder flashes. Capt. Robinson and Lieut. Pipon had taken a special course in astronomy from the Astronomer Royal, Professor Airy at Greenwich. Within sight of Quebec City in September, 1844, Sergeant McGuckin of the Royal Sappers and Miners with a party cleared timber from the top of a high hill, leaving one tall tree standing. Stripping it of its branches they fixed a small pulley to the tree top and then a charge of gunpowder was wrapped, hoisted, and then exploded. This operation was repeated every ten minutes each evening, and was designed to provide a longitude determination. Lieut. Pipon in Quebec City observed the flashes which were found to be more effective for observation purposes than the firing of rockets.[10]

Instruments used by the British commission surveyors were two 30-inch transits; a 15-inch altitude and azimuth instrument, a 12-incher of the same type besides numerous smaller theodolites, reflecting circles, sextants, compasses, barometers and thermometers. Many of these were manufactured by the London, England, firm of Troughton and Simm.

In the meantime progress had been made in surveying the international boundary line through the Great Lakes system under Article Six of the Treaty of Ghent. Anthony Barclay had been named for Great Britain and Peter B. Porter for the United States as boundary commissioners. They met in February, 1822, in Utica, N.Y. and gave instructions under Article Seven for the surveys from Lake Superior to the North West Angle of the Lake of the Woods. This imposing task required four full seasons of surveying to complete. Most of the surviving records of this project are the work of David Thompson who was selected to be in charge of the Canadian survey party. Williamstown was then Thompson's home. Realizing the need of a light boat for such field work Thompson supervised the designing and construction of such a craft, even to the cutting of the cedar logs.

The surveyors had been instructed to ascertain the position of the Long Lake mentioned in the 1783 treaty and if they failed to find any such lake to locate the chain of waters likely intended by the treaty-makers to govern the boundary. Surveyors made the month-long boat trip by way of the Ottawa River, Lake Nipissing, French River and Georgian Bay route. Inevitable delays required travel from dawn to dusk; the customary routine involved starting just after dawn, paddling for several hours, then going ashore for breakfast. The only other interruption in the day's journeying was time off for a shore luncheon. The crew had no cook and each man's rations were weighed out to him carefully once or twice a week. Reserve food stores were kept under lock. A daily ration consisted of a pound of salt pork or beef, a pound of biscuit and a half-pint of corn or, occasionally, dried peas. On one occasion, so Thompson relates in his diary, his men stole a few pounds of biscuits and a piece of salt beef from him. These rations were supplemented to some extent by fish and game. Once in a while a little sugar or whisky was doled out. Wages of boundary survey laborers ranged from $17 to $20 a month with board. One assistant surveyor hired by Thompson was paid at the rate of £24 7s 6d a month.[11]

These treaty surveys were carried on in the seasons of 1823, 1824 and 1825. In the early summer of the latter year Thompson took ill with dysentery and his son Samuel continued to direct the field party. On August 3rd David Thompson resumed control of the survey. By late September the entire project was completed and in early October at Sault Ste. Marie the survey equipment was sold. The transaction brought little cash as the bidders possessed slim financial resources. During the busy 1825 season Dr. Tiarks, the British astronomer, proceeded to the Lake of the Woods to select the Northwesternmost Point or Angle. Apparently on the basis of previous surveys by David Thompson it had been decided that the point should be either at what is now Kenora or at the northern part of the bay now known as the Northwest Angle Inlet. The question was decided by Tiarks in favor of the latter on the principle that the northwest point was that which, if a line were drawn in the plane of a great circle—thus forming an angle of 45 degrees with the meridian—would cut no other water in the lake. He determined the relative position of the alternative points by means of their latitudes and longitudes, the former being fixed by use of a sextant, the latter by the use of several chronometer determinations. This point was located at 49 degrees 23 minutes and 55 seconds north latitude and 95 degrees 14 minutes 38 seconds west longitude. Maps and reports were submitted at New York in October, 1826. The commissioners failed to agree completely and submitted separate reports to their respective governments. The maps thus compiled were used in the Webster-Ashburton settlement of 1842 when the boundary line in that region was finally defined.

At a time when field work was getting under way on the delineation of the New England-Quebec boundary, a border crisis was fast developing on the other side of the continent. The United States had won the race for the effective settlement of the Oregon country. By May, 1844, the Democratic Party in convention adopted a declaration calling on the United States to claim ownership of all territory in the Pacific Northwest as far as 54 degrees 40 minutes north latitude. This declaration was popularly interpreted in the jingoistic party slogan "Fifty-four forty or fight". This may be the only election cry ever created to make use of a latitude description.

Many feared the outbreak of hostilities but saner thoughts prevailed. President Polk, elected at least in part on the basis of that aggressive platform assertion, deemed it his duty, nevertheless, to arrive at a peaceful solution. In June, 1846, the British Minister to the United States, Hon. Richard Pakenham, forwarded a draft treaty to the Secretary of State in Washington, D.C. This text quickly won Senate approval and the pact, now known as the Oregon Treaty, was signed on June 15, 1846. Canadians had little if any voice or influence in the shaping of these far-reaching developments.

Extensive gold finds in the interior of British Columbia and the resulting influx of American miners in large numbers emphasized the pressing need for an international boundary line located and marked on the ground and in channels in conformity with Article One of the 1846 treaty. Just ten years after the Oregon pact, on August 11, 1856, Congress provided for the appointment of United States representatives on a joint boundary commission, Archibald Campbell being the chief delegate. On June 17, 1857, the American party sailed for Victoria to meet Capt. James Charles Prevost, commander of H.M.S. *Satellite*, aboard his ship in Esquimalt harbor, and for a second meeting on the *Satellite* at Nanaimo three weeks later. Both meetings proved abortive, however, due to the delay in the arrival of Capt. George Henry Richards of the British survey steamer *Plumper*. However, when he did finally arrive on the scene Capt. Richards cooperated fully with United States Coast and Geodetic Survey in making a complete survey of all islands and channels along the proposed boundary route.

It was not until the summer of 1858 that the British commissioner for the survey of the Pacific Northwest land boundary, Col. John Summerfield Hawkins of the Royal Engineers, arrived from England. He had the assistance in the field of Capt. Robert Wolseley Haig, astronomer, and of Lieut. Samuel Anderson, R.E., secretary to the British part of the commission. Col. Hawkins appeared to be at ease whether he was interviewing or corresponding with men in the highest government circles in London and Washington, D.C. His letters to the Secretary of State for Foreign Affairs in London and to the U.S. Secretary of State as well as to the British Ambassador in Washington reveal competence as a field party leader and an exceptional ability and readiness to discuss his boundary survey problems with men at the summit of public affairs in his day.[12]

At a joint meeting attended by Hawkins and Campbell, the U.S. commissioner, it was agreed that it would be inexpedient to undertake to mark the entire boundary through dense forest by cutting tracks. Rather the decision was to ascertain points on the line by astronomical observations at convenient intervals and to mark such astronomical stations by cutting a track not less than 20 feet in width on each side of the line for a half-mile or so. The cost of the United States surveys in this region was $1,463 a mile or a total of $600,000.[13] Because excitement in the interior over the gold discoveries was growing rapidly at the time of Col. Hawkins' arrival in British Columbia there occurred large, not to say embarrassing, increases in the cost of supplies for field survey operations. These were reflected in the official record of British survey expenses.[14] Work continued over several field seasons until the line was run from tidewater to the crest of the Rockies along the 49th parallel. The United States field work was completed in 1861 and that of the British section early in 1862. The final joint meeting of the commissioners took place in Washington, D.C., May 4 to May 7, 1869. On June 23, 1871, Sir Edward Thornton, British Minister to Washington, sent to the State Department an atlas of the newly-surveyed northwest land boundary. The maps were made by the British Ordnance Survey under the supervision of Capt. Parsons, R.E., and Sir Henry James, R.E.

Campbell's report to Washington on the U.S. surveys was lost under mysterious circumstances and never found. By coincidence the British report to London also disappeared from sight. It was not until 1898 when the distinguished Canadian astronomer and surveyor, Dr. Otto Julius Klotz, was visiting the Royal Observatory at Greenwich that he discovered, quite by accident, the missing British records in an Observatory storage room.[15]

A brief period of relative tranquillity prevailed in the border region following the treaty settlement but in 1859 a crisis developed over the ownership of San Juan Island in Georgia Strait. The treaty-makers, unaware of the actual geography of the region, had specified that the boundary should follow "the middle of the channel which separates the continent from Vancouver's Island". What they failed to realize was that several channels existed which could meet the specifications of the agreement. In 1859 when a trespassing, garden-raiding pig of English ownership on San Juan was shot and killed by an offended American neighbor, the owner of the dead animal threatened arrest of the shooter. But the American insisted on being tried in a United States court. Feelings were aroused among the island's inhabitants and the military commander of the U.S. Oregon Department ordered troops to occupy the island. British men-of-war appeared in the waters off San Juan. Once again General Winfield Scott was named trouble-shooter by Washington. With the aid of Rear-Admiral R. L. Baynes he persuaded Vancouver Island's irate Governor Douglas to agree to joint U.S.-British occupation of the island until the issue of sovereignty could be settled. Nevertheless, despite the careful surveys of 1857-58 there was no joint agreement on the water boundary line.[16]

By the Treaty of Washington, May 8, 1871, this inability to concur was recognized; note was taken of the fact that the British claimed Rosario Straits as the "middle channel" of the 1846 treaty whereas the United States claimed Canal de Haro to be the channel to which the negotiators referred. By this treaty the contending parties agreed to the arbitration and award of Emperor William I of Germany. On October 21, 1872, the Emperor decided in favor of the contention of the United States. This award rang down the final curtain on the prolonged drama that began in the "Year of the Pig" on San Juan Island.

In a protocol signed at Washington in March, 1873, by U.S. Secretary of State Hamilton Fish, Sir Edward Thornton and Rear-Admiral J. C. Prevost, the Canada-United States Pacific boundary line was finally established. The chart on which the line is defined is titled, "North America, West Coast, Strait of Juan de Fuca, and the channels between the continent and Vancouver Island showing the Boundary line between British and American Possessions, from the Admiralty surveys by Capts. H. Kellett, R.N., 1847 and G. H. Richards, R.N., 1858-62". Early in the 19th century this line was to be more accurately defined and marked.

East of the Rockies boundary surveys along the 49th parallel of latitude commenced in 1872 and required several field seasons to complete. These and other boundary surveys are described at a later stage in this history. In 1825, on February 28, a convention was signed between Great Britain and Russia setting forth the boundaries between their respective areas of operation in the Pacific Northwest of North America. When Alaska was purchased by the United States from Russia in 1867 the description of the boundaries of Russian possessions in America were taken practically direct from the 1825 convention. The significance of this latter agreement in relation to Canadian boundaries with the United States is dealt with later in connection with the development and ultimate resolution of the Alaska boundary dispute that raged in the declining years of the 19th century and into the opening years of the 20th century.

It is sufficient to quote at this juncture the concluding words of an editorial article in the Victoria *Colonist* of April 3, 1867: "To Russia the possessions to the north of us are of no political importance, but to the United States they may prove of incalculable value in view of the great and important change that has lately taken place on the continent".[17] This was a timely and perceptive comment on the world-shaping ebb and flow of forces and events just at a time when four Canadian provinces were on the verge of Confederation.

17

LOWER CANADA SURVEYS

In the span of somewhat more than 100 years between 1759 and Confederation, surveying and mapping in Lower Canada were dominated by four highly talented and dedicated men: Samuel Holland, John Collins, Joseph Bouchette, Sr. (1774-1841) and Joseph Bouchette, Jr. (1798-1881). Holland and the senior Bouchette occupied the office of Surveyor General for a total of 74 years. Coincidentally, each of them served in that capacity for 37 years. Neither Collins nor Bouchette, Jr. rose in title above the rank of Deputy Surveyor General yet each substituted with distinction for his respective chief over extended periods of time.

In previous chapters the outstanding achievements of Holland and Collins have been reviewed. The Holland-Collins era came to an end just after the close of the 18th century. The man chosen to succeed Holland was related to him by marriage. The senior Joseph Bouchette's grandfather, Marc Bouchette (originally spelled Bouchet) had come to Canada from St. Malo, France, early in the 18th century. Marc's only son was Jean-Baptiste (1736-1804), the man who became Commodore of the Provincial Navy of Canada and who made possible Sir Guy Carleton's daring and timely penetration of American lines in 1775 in order to reach Quebec from Montreal by way of the St. Lawrence.

Jean-Baptiste, was the first husband of Thérèse Grenet who, in her second marriage, became Mme François Rolette. Her daughter, Marie Josephte, became Mrs. Samuel Holland. The eldest of Jean-Baptiste Bouchette's children, Joseph, accordingly was a half-brother of Mrs. Holland. Joseph was born in 1774 and at the age of sixteen joined the staff of his (half) uncle, the Surveyor General. It is claimed that Holland and Bouchette worked in the Eastern Townships together on land surveys, with Joseph mainly occupied in sketching. Evidence of this particular association is scanty and such joint participation must have been confined to the season of 1790. In 1791 Joseph sought to emulate his father's example by joining the Provincial Navy. By 1793 his surveying abilities and training were recognized and he was commissioned to conduct a hydrographic survey of Toronto harbor, for which he received the munificent sum of £5 16s and 18d. Lieut. Bouchette described the locality:

"I still distinctly recollect the untamed aspect which the country exhibited when first I entered the beautiful basin, which thus became the scene of my early hydrographical operations. Dense and trackless forests lined the margin of the lake, reflecting inverted images in its glassy surface. The wandering savage had constructed his ephemeral habitation beneath the luxuriant foliage—and the bay and neighboring marshes were the uninvaded haunts of immense coveys of wild fowl—indeed they were so abundant as in some measure to annoy us during the night".[1]

During his service on the Great Lakes J. Bouchette Sr. refloated his father's flagship *Onondaga,* given up for lost. During the winter of 1794-95 he was employed as a draftsman making copies of a map of Upper Canada for which he was paid at the rate of 5 shillings a day. When the Provincial Navy was drastically reduced in 1796 Bouchette was let out but he soon acquired a lieutenancy in the Royal Canadian Volunteers, an army unit. In 1797 he married and in the following year Joseph was born. In 1801 he returned to the staff of the Surveyor General of Lower Canada and about this time was promoted to the rank of Lieutenant Colonel. When Holland died in December of that year, Bouchette was made acting head of the office. Soon he won the complete confidence of the authorites and in August, 1803, was named Surveyor General, an appointment formally confirmed in 1804.

Two years later Bouchette made a survey report on the seigniory of St. Maurice, a survey compiled from direct personal observations, studies by assistants and from documents and maps supplied by seigniors. In the following year he went to London, England, in connection with the better definition of the Canada-United States boundary. By August, 1807, he had returned to North America by way of New Brunswick where he commenced a study of the topography of the British Atlantic provinces. During the 1812-14 war the senior Bouchette was active in the army. In 1814 a committee of the legislature of Lower Canada recommended that he be granted £1,500 in aid of his proposed publication of a map-illustrated catalogue of information on the province. That summer, supported by £500 advance on the grant, Lieut.-Colonel Bouchette again proceeded to England. While in London he was named a special surveyor under the Ghent Treaty provisions in order to work with an American counterpart on the Canada-United States boundary line. A perfectionist, Bouchette took lessons in astronomy in order to improve his qualifications for participating in boundary line surveys. The legislature, in the meantime, had reneged on the balance of its undertaking to finance Bouchette's catalogue of the province. It was 60 years before the house finally reimbursed him but it did so without paying any interest on the long overdue sum.

By 1817 his son had become one of two deputies serving in the office of the Surveyor General during his frequent and occasionally extended absences from Quebec. On February 16, 1819, Joseph Bouchette, Jr., was commissioned a practising surveyor. Later that same year he was designated to draw a plan of Quebec and vicinity. Within eight years this grandson of the gallant commodore was to become Deputy Surveyor General of Lower Canada.

In the spring of 1817 boundary survey operations began in the field and after the erection of a monument jointly with the American surveyor, John Johnson, at the source of the St. Croix River, a line due north from there was established. During the following survey season Bouchette, with his American opposite number, proceeded to establish the international boundary along the 45th parallel when Bouchette suddenly became danger-

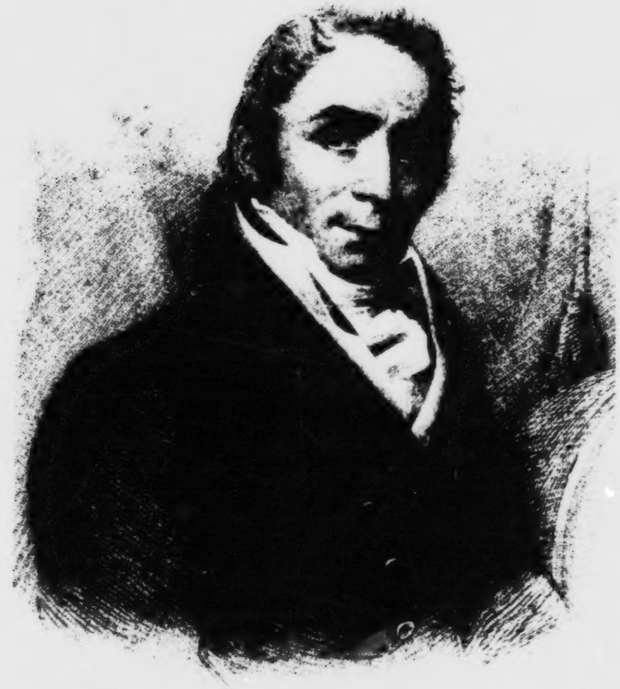
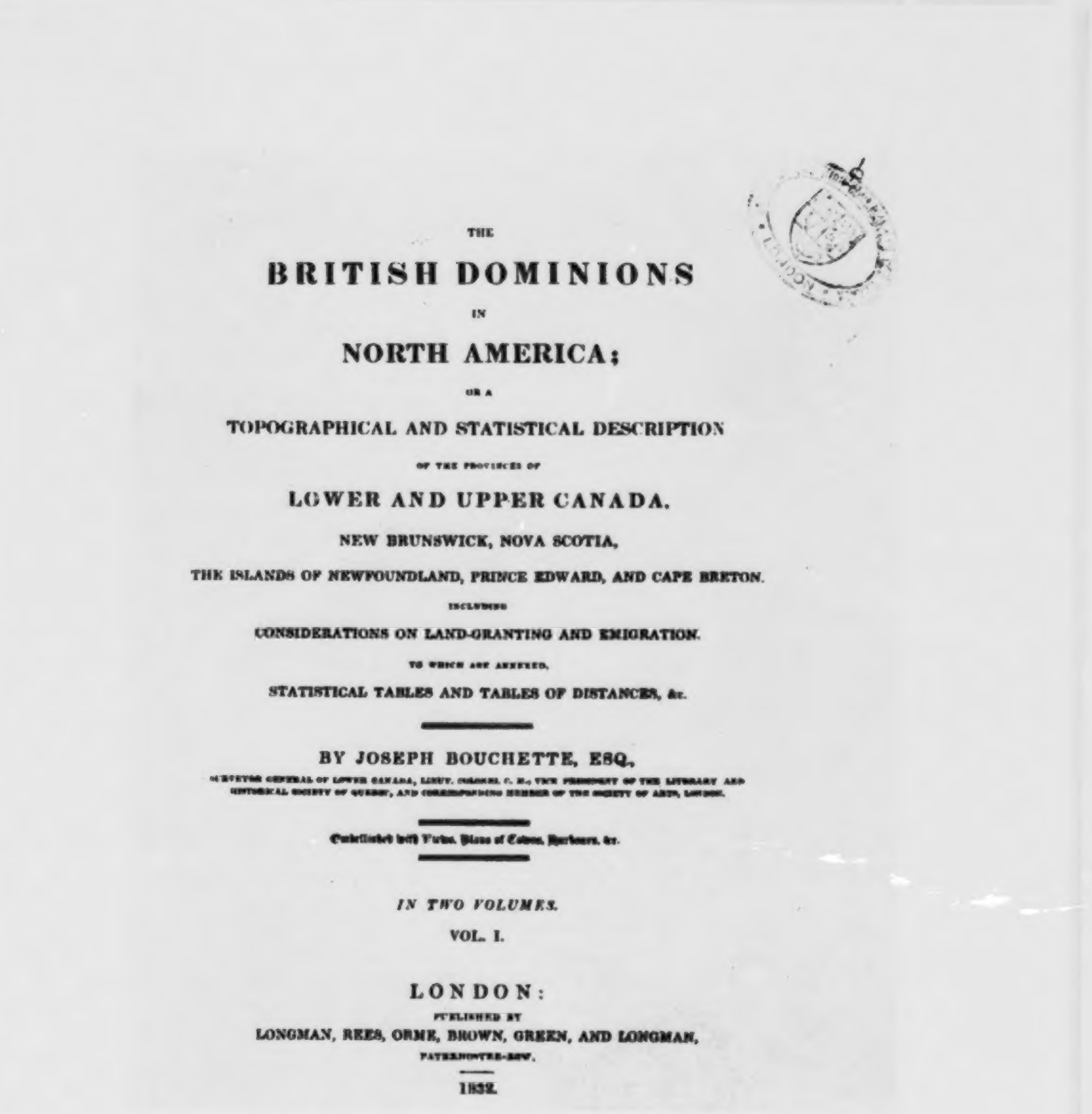


FIGURE 35
Joseph Bouchette.

ously ill. His place was taken by Dr. Tiarks for the remainder of that season.

In the meanwhile Bouchette's magnum opus, *A Topographical Description of the Province of Lower Canada (With Remarks upon Upper Canada)* had been published by W. Faden, London, in 1815. The volume was "embellished by several views, plans of harbours, etc.". There was a general map of British North America and parts of the United States as well as a map of Lower Canada on a scale of 2½ miles to an inch. This book was dedicated to George Augustus Frederick, Prince of Wales and Prince Regent of the United Kingdom of Great Britain and Ireland. The future George IV had taken a personal interest in Bouchette's work and received a complimentary copy from the author's own hand at Carleton Palace.

In the Preface the author emphasized the desirability of better maps of his native land: "The interior of Lower Canada being so little known beyond the limits of the province, a belief that a detailed account of it would not only be useful in shewing its present state, but by bringing it under more general notice, might possibly *assist in the development of its vast resources*, has led to the construction of a topographical map upon a large scale and to the publication of the following Book to illustrate the same more fully". (author's italics). Once again in the story of Canada's progress the note is struck recalling the close association of mapping and surveying with the proper utilization of the renewable and non-renewable natural resources of a country.



THE

BRITISH DOMINIONS

IN

NORTH AMERICA;

OR A

TOPOGRAPHICAL AND STATISTICAL DESCRIPTION

OF THE PROVINCES OF

LOWER AND UPPER CANADA.

NEW BRUNSWICK, NOVA SCOTIA,

THE ISLANDS OF NEWFOUNDLAND, PRINCE EDWARD, AND CAPE BRETON.

INCLUDING

CONSIDERATIONS ON LAND-GRANTING AND EMIGRATION.

TO WHICH ARE ANNEXED,

STATISTICAL TABLES AND TABLES OF DISTANCES, &c.

BY JOSEPH BOUCHETTE, ESQ.,

SURVEYOR GENERAL OF LOWER CANADA, LIEUT. COLONEL C. M., VICE PRESIDENT OF THE LITERARY AND
HISTORICAL SOCIETY OF QUEBEC, AND CORRESPONDING MEMBER OF THE SOCIETY OF ARTS, LONDON.

Embellished with Views, Plans of Towns, Harbours, &c.

IN TWO VOLUMES.

VOL. I.

LONDON:

PUBLISHED BY

LONGMAN, REES, ORME, BROWN, GREEN, AND LONGMAN,

PATERNOSTER-ROW.

1832.

FIGURE 36. Title Page of Volume One of Joseph Bouchette's two-volume work (London, 1832).

This monumental literary effort was not the only contribution made by the Bouchettes to geographical knowledge of their country. In 1832 Longman and Green of London published in two volumes the Surveyor General's *The British Dominions in North America: Or a Topographical and Statistical Account of the Provinces of Upper and Lower Canada, New Brunswick, Nova Scotia, The Islands of Newfoundland, Prince Edward and Cape Breton with Topographical Maps of Lower Canada and a Geographical Map of the British Provinces in North America.* In the same year Wyld of London published, also by the senior Bouchette, *Topographical Dictionary of Lower Canada.* This work contained a map of Canada on a scale of 3 miles to the inch. At the same time Joseph

Bouchette, Jr. had his map of British North America published in London on a scale of 14 miles to the inch. This was issued in a larger, revised edition in New York in 1846.

The Geological Survey of Canada, according to Logan's Preface to his 1863 Report, found the large 1832 map of Canada especially helpful and Logan commented that the maps of this father and son combination "have served for laying down preliminary sketches of the geology of the older settled and better surveyed sections".

References to surveying are relatively sparse in Bouchette's 1815 work. He describes the Valentine-Collins line as being "irregular in the field, at some places inclining towards the north, and at others diverging towards the south. . . . The correctness of the position of St. Regis is unimpeachable; but it deviates widely from its true latitude at the monument on the Connecticut, which spot is nearly on the meridian of Quebec . . . Proceeding on that [confirmed] datum the boundary line proves to be at the Connecticut an encroachment upon the province of Lower Canada *exceeding three geographical miles*".* (author's italics)

In his 1832 book Bouchette refers to four meridian stones fixed in 1790 by Major Holland on the Plains of Abraham, representing the astronomical north . . . "One of them stood in the angle of a field redoubt where General Wolfe is said to have breathed his last . . . tourists for souvenirs kept breaking off pieces of this stone over thirty years".

Bouchette also pointed out that the primary object for which these meridian stones had been installed had been defeated by the extension of the suburbs of St. Louis and St. Jean, the structures of which impeded the view from one stone to another.

Bouchette drew attention as well to an aggravating situation arising out of the drawing of district boundaries in Lower Canada: "On the north side of the St. Lawrence they are identified with seignioral divisions. But on the south side they are only ideal lines, prolonged to the boundary of the province, not only cutting several townships but even farm lots, placing them in two districts". In too many instances, apparently, persons summoned to attend court hearings had travelled long distances, say to Montreal, before discovering that their attendance was, in fact, required in the district court of Three Rivers! Bouchette argued for a revision of district and county boundaries and suggested a practical remedy.[2]

Bouchette left a notable legacy of maps and plans. These included a plan (1813) of the waterway between Montreal, Kingston and Sackett's Harbour; a plan (probably 1817) of exploration of a line northward from the monument at the source of the St. Croix River . . . in conformity with the Ghent Treaty; his 1815 topographical map of Lower Canada with divisions into districts, counties, seigniories and townships and showing lands reserved for the crown and clergy; his 1815 map of Upper and Lower Canada with boundaries with the United States; his 1832 map of Montreal showing part of Upper Canada and the 1832 general map of British possessions in North America as well as an 1815 plan of "the route from Halifax to River Du Loup".

In 1822 when a Lower Canada Committee was formed to promote the idea of political union of Upper and Lower Canada the senior Bouchette was the only Canadian of French extraction to sit on this body. His sustained enthusiastic support of this cause resulted, ironically enough, in the abolition of the title of Surveyor General of Lower Canada. After union that title was dropped and never used again officially in the province. It was swallowed up in the continuing office and function of the Commissioner of Crown Lands and his department.**

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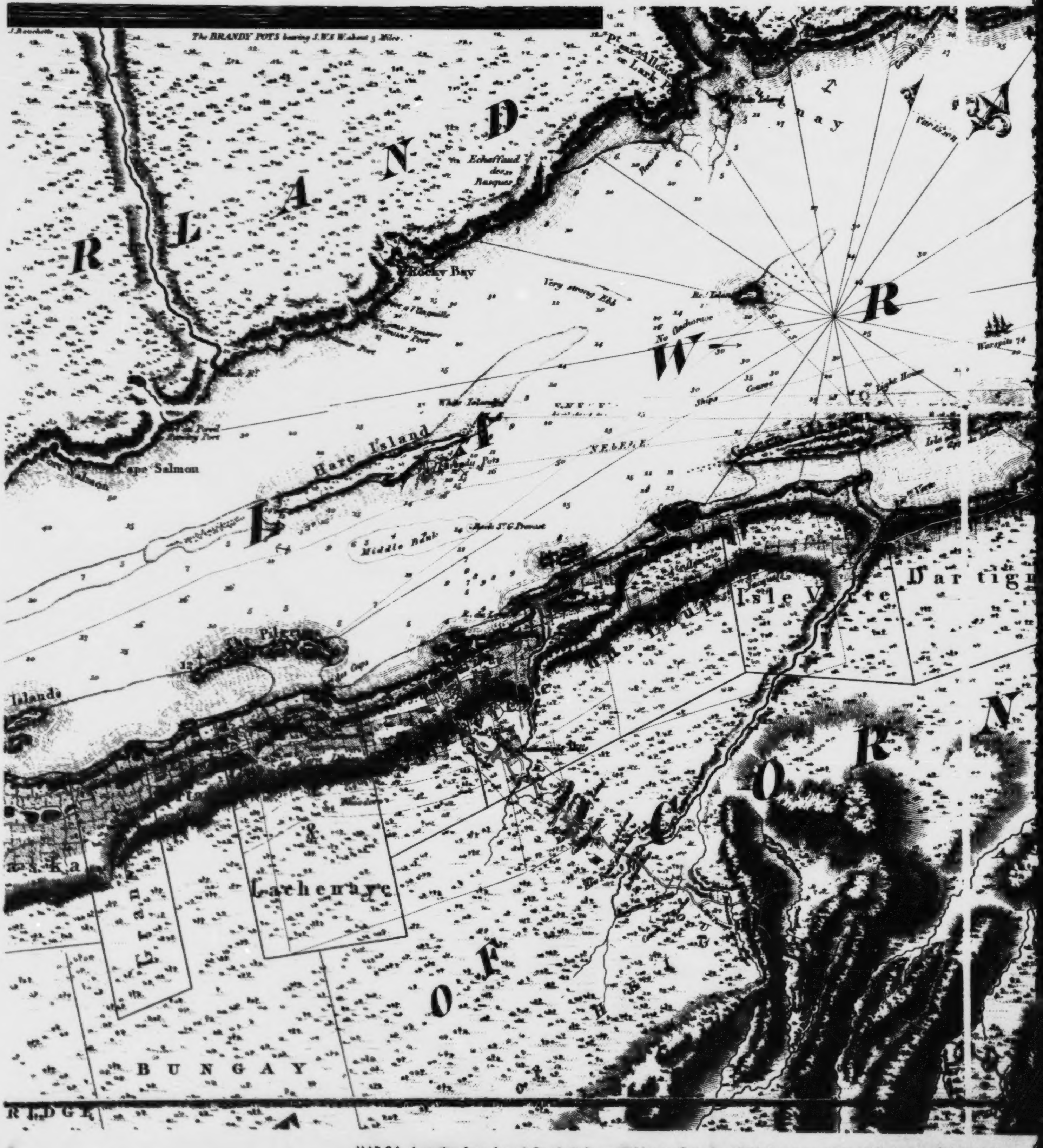
*Page 278 of Bouchette et seq.

**Formally confirmed by 8 Vic. ch. 11, sec. 1.


J. Bouchette
The BRANDY POTS bearing S.W.S W. about 5 Miles.
Pt. aux Allouettes
or Lark Pt.
R L A N D
Echaffaud des Basques
Rocky Bay
Very strong Ebb
Red Island
No Anchorage
W
R
Var. 15°
Warspite 74
Ships Course
Light House
White Island
Hare Island
Brandy Pots
Cape Salmon
L
Middle Bank
Rock St. G. Provost
Pilgrims
Islands
Isle Verte
Dartign
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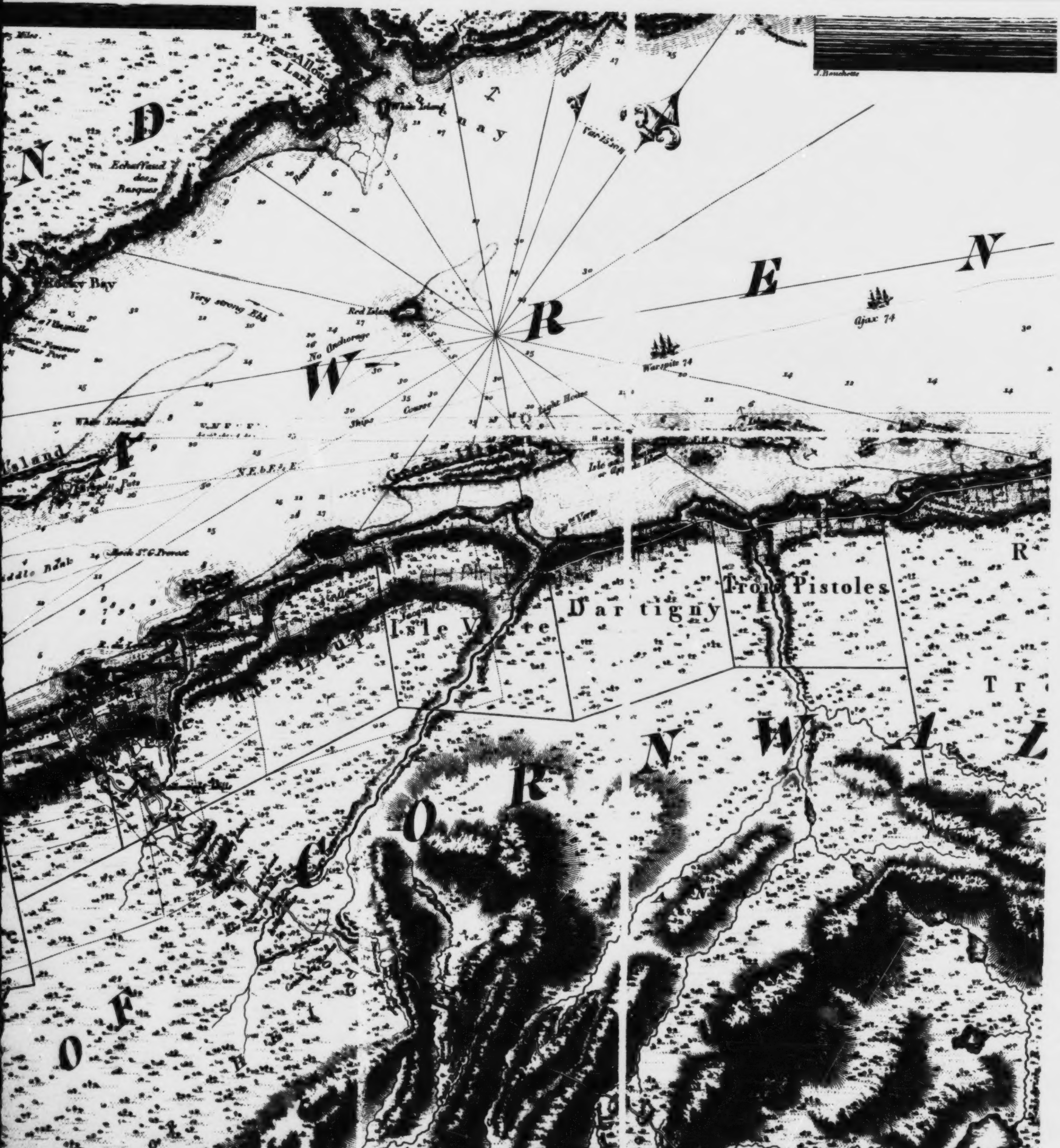
OF
BUNGAY
RIDGE

MAP 34. A section from Joseph Bouchette's map of Lower Canada, 1815. Courtesy of the Public Archives of Canada.


J. Bouchette
Rocky Bay
Echaffaud des Basques
Very strong Ebb
Red Island
No Anchorage
Ships Course
Light House
White Islands
N.E.b.E.½E.
Ajax 74
Warspite 74
Isle Verte
Dartigny
Trois Pistoles
Var 15 deg

34. A section from Joseph Bouchette's map of Lower Canada, 1815. Courtesy of the Public Archives of Canada.

Soon after this development Joseph Bouchette died. His passing on April 9, 1841, was widely mourned. Sir George Étienne Cartier, on the floor of the Legislative Assembly, delivered an eloquent and stirring tribute: (translation) "An eminently distinguished man, Mr. Joseph Bouchette, has done everything for the topography and geography of the land. This man was truly ahead of his century in our country. He provided the Canadian people with a vast store of information which has remained the foundation of their geographical knowledge . . ."[3] A newspaper editorial tribute, in part, reminded readers that "he honestly and faithfully served not less than four sovereigns [George III, George IV, William IV and Victoria] and for his veneration and attachment to constitutional government and for perpetuation of the connection of Canada with Great Britain the late Surveyor General was most conspicuously distinguished".

Today in Quebec City a memorial plaque placed on the wall of a structure at 35 St. Louis Street commemorates his half-century of service in the military and civil service and, in particular, his 37 years as Surveyor General of his native province. Some historians maintain that the plaque would have been more correctly placed on the dwelling across the way, 34 St. Louis Street, his actual place of residence.

Two brothers of Joseph Bouchette, Jr. were on the Surveyor General's staff at Quebec. The names of Jean-François and Robert Shore Milnes Bouchette are listed as clerks in the *Quebec Almanac*, along with William Saxe and others in the 1820s and 1830s. R.S.M. Bouchette, named after a Quebec governor and close friend of his father, worked in 1823 on Canada-United States boundary maps, under the nominal direction of Thomas Barclay. In all there were 25 maps of varying sizes to be copied and Robert writes of the 6-hour work days—"we could not work after sunset when lighting was scarce and expensive". Three months of close application were required to complete the important assignment. Following the 1837 civil disturbances in Lower Canada, Robert was banished to Bermuda, apparently for taking part in the insurrection.

Joseph Bouchette, Jr. served a busy apprenticeship in his father's employ. The excellence of his 1819 plan of Quebec and vicinity led to a request to prepare a plan of the city and port of Montreal, with all harbor improvements. This plan was dated 1824. On May 12, 1827, after some ten years in his father's office young Bouchette, at 29, was named Deputy Surveyor General of Lower Canada and remained in that position after Union and well into the Confederation period despite the disappearance in the meantime of the title of Surveyor General. A Department of Crown Lands memorandum dated June 29, 1867, is signed by him as Deputy Surveyor General. This document pertained to the Ottawa River boundary line between the two Canadas. In 1878 Joseph Bouchette, Jr. retired on pension, dying on February 24, 1881, at 83 years. The regime of the two Bouchettes had extended over 75 years of active administration in the sphere of 19th century surveying and mapping in what had been Quebec, later Lower Canada, then Canada East and finally, the province of Quebec in the new Confederation.

Joseph Bouchette, Jr. had forecast in 1831 that within 50 years British North America would contain ten million persons.[4] His estimate proved to be somewhat generous. Actually in 1881 Canada possessed a total population of about 4,325,000. Nevertheless it was constructive optimism such as that of the younger Bouchette that helped Canada develop into a nation of consequence in the 20th century.

According to the *Quebec Almanac* (John Neilson) there were in Quebec province in 1797 a total of 34 listed surveyors. The list had grown steadily to 50 by 1808. By 1832 the number had reached 100 and remained at about that level for the ten following years. Land surveyors in the Montreal area formed a considerable proportion of all practising surveyors in the province from 1759 to 1867. A representative list of these men has been compiled and is reproduced here.[5] The bracketed information indicates the period of the most fully recorded surveys of each man: Pierre Arseneau (Arsenault) (1762,63); Pierre Beaupré (1791-1820); Louis Charland (1792-1813); Pierre Dézéry (1792-1800); Jean Delisle (De Lisle) (1768-71); M. D. de Glandons (1796-1802); F. des Dev. de Glandons (1800- ?); François Enouville-Lanoix (1772- ?); François Fortin (1770-73); Joseph Filion (1773- ?); P.-P. Gagnier (1782- ?); Jn. Gaudet (1787-88); Amable Gipouloux (1776-1809); E. Guy (1798-1819); Thomas Guerin (1847); J.-B. Grenier (1770); J.-B. Perrot (1762-74); Jean Pennoyer (1788-1806); J.-B. Plamondon (1735-95); Ignace Plamondon, his son; Joseph Papineau (father of Louis-Joseph) (1773-75); and his son, François Papineau (1791-1821); William Saxe (1797-1825) and Charles Turgeon (1792-1803). Also according to the *Quebec Almanac* there were in 1797 elsewhere in Quebec province (including Upper Canada) a number of qualified active surveyors including William Fortune, Joseph Fortune, James Rankin, John Stegman, Jeremiah McCarthy, Joseph Whitman and William Waller.

Land-survey conditions during the period immediately preceding Confederation are revealed in the diaries of F. W. Blaiklock, a surveyor commissioned on February 20, 1843. On August 7, 1847, he was instructed by the Commissioner of Crown Lands to establish on the ground an exploration line of slightly more than 100 miles in length to the south shore of Lake St. John . . . ". . . through astronomical observations you will determine with the utmost degree of precision the latitude and magnetic variation . . . then follow N.15° W in a straight line until intersection is made with the shore of Lake St. John . . ."[6]

Blaiklock's track was to be marked by tree blazes, careful daily examination of his surveyor's chain in order to keep it accurate for measuring. He had two survey teams of ten men each, in addition to the surveyors and an "explorer". M. Duberger headed one party and Blaiklock the other. The qualified surveyors received 20 shillings a day, the explorer 10 shillings, and chainmen 5 shillings. All were allowed 1½ shillings a day for rations which for the most part comprised biscuits, lard, beans, peas and salt. At the risk of smothering enthusiasm it was stipulated that no one would be paid until completion of the work!

The survey began on September 16. Steady application to the task under most trying conditions was required to complete 41 gruelling miles by Christmas Day, 1847. On October 14 there had been more than a taste of approaching winter when the parties encountered a snowfall of 14 inches. Alternately mild and very cold weather taxed the health and endurance of the men. Some of them suffered frozen feet after wading in ice-cold rivulets and pools of melted snow, only to experience subsequent spells of heavy frost. At first progress was at the rate of a mile a day but even this modest pace could not be maintained. Deep ravines and rugged hills demanded effort to the point of physical exhaustion. On November 2 the teams were threatening to give up working. Somehow Blaiklock persuaded them to remain on the job. By Christmas Day, however, provisions had reached a low ebb. Nevertheless by November 12, 1848, 104¼ miles of line had been laid down and the exacting assignment concluded.

Justice would not be done to the history of surveying in Lower Canada prior to Confederation without reference to the Laurier family. At St. Lin, Quebec, on November 20, 1841, Henri Charles Wilfrid Laurier was born "of the lawful marriage of Carolus Laurier, gentleman, land surveyor — and Marie Marcelle Martinault (Martineau)". This boy became Sir Wilfrid Laurier (1841-1919), Prime Minister of Canada from 1896 to 1911. The boy's paternal grandfather, Charles, was also a land surveyor of considerable prominence. He had surveyed a great part of the ancient seigniory of

Lachenaie. Charles had a pronounced inventive turn of mind and, among other such accomplishments, in 1822 devised a "land log", an ingenious mechanism designed as an attachment to a carriage wheel. In this way it became possible to measure and to register distances traversed by the wheel. The log recorded automatically the number of revolutions of the wheel, the dials indicating leagues and fractions of leagues travelled. Charles appealed to the Quebec legislative assembly for a patent and after the politicians had consulted Surveyor General Bouchette and E. D. Wells, a Quebec watchmaker, the patent was issued in 1826.[7]

Carolus, son of Charles Laurier, was born in 1815. He was a surveyor who also maintained a farm at St. Lin. In 1834 he married an Acadian girl. In his field surveys, which extended from 1842 to 1886, Carolus made many firm friends in the predominantly Scottish-Canadian village of New Glasgow, seven miles from St. Lin. In New Glasgow Wilfrid, at the age of eleven, began attending school and for two years lived with English-speaking families. This experience proved invaluable to him in later life when he entered public affairs. The wisdom of his surveyor-farmer father was more than vindicated.

The coming of the United Empire Loyalists to central Canada and the corresponding need for increased and more rapid property surveys resulted in a marked advance in the legal status of surveying in Quebec. The authorities found it advisable to promote a solid foundation in the form of laws and regulations governing the practice of surveying. The responsibility of the surveyor to the general public was recognized in statutory safeguards against possible abuses or incompetence. Qualifications for admission to the profession were defined and a scale of fees authorized. Penalties were provided for infractions of the law. Even before the senior Bouchette joined Surveyor General Holland's staff, legislation in this field included the 1785 ordinance concerning land surveyors and the admeasurement of lands (25 Geo. III ch. 3) and the 1798 enactment (38 Geo. III ch. 3). In the Bouchette period this pioneer legislation was superseded by a series of statutes on surveying including that of 1817 (57 Geo. III ch. 26) that extended the 1798 act to provide for the establishment of meridian stones by astronomical observations in towns, parishes and seigniories.

A key enactment in this succession of laws was that of 1832 (2 William IV ch. 21) that repealed the 1785 law and provided that applicants for the title of "land surveyor" be duly examined by the Surveyor General or Deputy Surveyor General and four other competent persons, named by the Governor, "as to fitness and capacity, character and the efficiency of his instruments". If the applicant passed all tests he was authorized to practice as a public surveyor and was provided with a certificate to that effect. This 1832 measure, in several respects, may be regarded as the statutory cornerstone of modern Canadian surveying.

By section two of this 1832 act no person could practice as a land surveyor until he was 21 years of age and qualified in regular courses of geometry, trigonometry and astronomy *sufficient to enable him to draw a meridian* and provided that he must serve three successive years as an apprentice. (author's italics) Security had to be given in each instance to the Crown in the sum of £50 and an oath taken to perform survey duties "without favour, affection or partiality". Under a section of this act meridian lines were drawn and marked in or near the cities of Quebec and Montreal and the town of Three Rivers, by which lines surveyors of land were to verify their instruments at least once a year.

In 1841-42 (4-5 Vic. ch. 9) and again in 1849 (12 Vic. ch. 35) amendments to existing laws were made. In the case of the former act it was provided that anyone guilty of hindering a surveyor in the carrying out of his duties could be punished by fine or by prison term. Between these two legislative developments the 1845 enactment (8 Vic. ch. 11) had consolidated the office and functions of the Surveyor General of Lower Canada with the Department of the Commissioner of Crown Lands under the title of the latter official.

By making improved provision for the admission of a land surveyor to practice, the 1849 measure expedited his transformation into an independent professional man. With the establishment in Upper Canada of the formal apprenticeship system, instituted in Lower Canada in 1832, training was placed on a sounder footing in the newer province. In Lower Canada surveyors were required to keep their survey records (procès verbaux) correctly, to sign and index same. On the death of a surveyor his procès verbaux became part of the public records of civil courts... In Upper Canada property plans were to be certified as correct by a land surveyor and filed in county registry offices. Surveyors in Upper Canada, under this legislation, were required to keep exact and regular journals and field notes of all their surveys and to properly file the same.

The Commissioner of Crown Lands was directed by the 1849 act to procure a standard English measure of length and a standard of the old French measure of length, these to remain in his office for the purpose of comparing therewith the standards to be kept by each qualified surveyor. A brass bar measuring a standard English yard in length, with scale graduations was obtained in 1850 from Troughton and Simms of London. Replicas of this bar, in the form of wooden yardsticks, were supplied to surveyors in Upper Canada until about 1900 when the sticks were replaced by standard steel tapes, 33 feet long. The original brass bar supplied to the Board of Examiners' office in Toronto is now in the keeping of the Association of Ontario Land Surveyors.

All sections of 12 Vic. ch. 35 (1849) inconsistent with the bill passed on August 2nd of 1851 (14-15 Vic. ch. 4) were repealed thereby. This 1851 measure provided for the establishment of separate boards of examiners of 8 members each in addition to the Commissioner of Crown Lands who was empowered to sit on both boards. These bodies passed upon applicants for admission to the practice of surveying. The board for Lower Canada was located at Quebec and that for Upper Canada at Toronto. Apparently the former one-board arrangement was unsuitable for so large a territory and resulted in great inconveniences.

In 1855 by 18 Vic. ch. 83 additional matters involved in examination procedure were covered. An examination before apprenticeship was instituted, the applicant being tested in vulgar and decimal fractions, square and cube roots in addition to geometry and trigonometry.

In 1841 another venerable office in the structure of the civil administration, first of New France, then of Lower Canada, was discontinued, that of Grand Voyer. The functions performed by this official were peculiar to the French-speaking community. The Grand Voyer was an overseer of highways but he was more than that. He not only supervised road building, he selected the route to be followed as well as those responsible for construction of the road.[8] The office of the Commissioner of Crown Lands, however, assumed increasing importance during the quarter-century immediately preceding Confederation. As a rule the commissionership was filled by a man of cabinet rank but seldom was any occupant in the office for long. When Hon. Joseph Cauchon resigned from the position in June, 1857, Sir Étienne P. Taché, although continuing to serve as Speaker of the upper house, assumed the duties of Commissioner until November of that year. He carried the extra load of duties rather than put the country to any additional expense during that period, functioning as Commissioner without pay.[9] Sir Étienne, a descendant

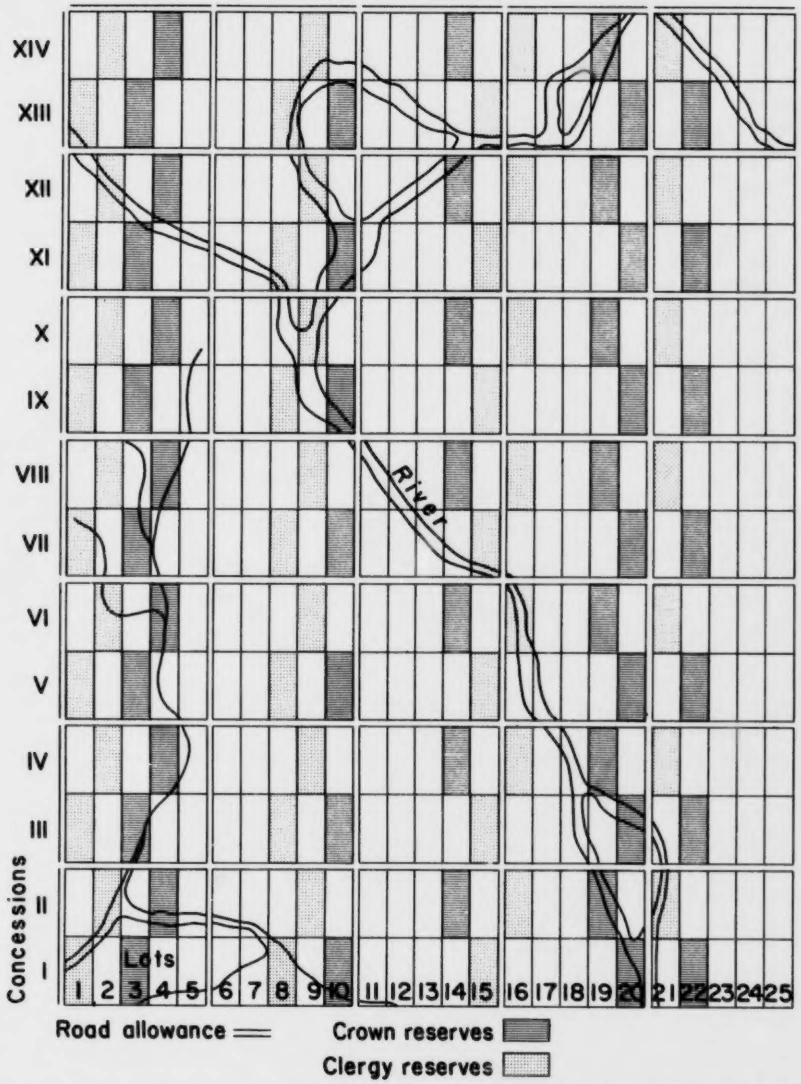

XIV
XIII
XII
XI
X
IX
VIII
VII
VI
V
IV
III
II
I
Concessions
Lots
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
River
Road allowance ══
Crown reserves
Clergy reserves

FIGURE 37. Diagram showing pattern of distribution in an average township in central Canada of Crown and Clergy Reserves in accordance with the Constitutional Act, 1791, applicable to Upper and Lower Canada (after *Historical Atlas of Canada*, ed. D. G. G. Kerr, Thomas Nelson and Sons (Canada) Ltd., 1960.)

of Louis Jolliet, presided at the Quebec Conference of 1864 and although he is regarded as a Father of Confederation, did not live to see Confederation become a reality.

About the middle of the 19th century Canadian surveyors had become deeply impressed with the need of membership in an organization of like-minded professional people. In March, 1859, an Association of Architects, Civil Engineers and Provincial

Land Surveyors of the Province of Canada was founded. W. Thomas of Toronto was its first president and George Brown of Montreal its first vice-president. The association faded but it is significant that at one of its early meetings the membership heard a paper from Mr. Hanvey of St. Thomas "On the Allowance to be Made for Curvature of the Earth in Surveying". Minutes of the meeting indicated that such curvature was a definite factor in surveying in Canada "where frequently the first line of survey is run on a true meridian, and the others parallel or rectangular to it". Experience in this form of fraternization convinced surveyors of Quebec province of the advantages of organization on a professional basis. In 1882 by an act passed on May 27 (45 Vic. ch. 16) the Corporation of Quebec Land Surveyors—Corporation des Arpenteurs-Géomètres de la Province de Québec—was founded with M. Charles Baillairgé as its first president.

In 1854 an ancient system and a long-established practice were discarded in Lower Canada. As both system and practice related directly to land tenure in Canada these developments were of interest to surveyors and mappers. Nearly 8 million acres had been granted under the seigniorial system since its first appearance on the shores of the St. Lawrence in the early 17th century. About one-quarter of all these land grants were owned by the Roman Catholic church. Some abuses had developed but nothing like the harsh tyranny experienced in the Old World. From the onset of British rule in Canada this New World version of feudal land tenure was doomed. Most of the agitation for the system's discontinuance came from outside Quebec province. Nevertheless the system was becoming in the 19th century more and more anachronistic. In 1854, after prolonged legislative inquiries the seigniorial system was formally abolished.

"Clergy Reserves", lands "equal in value to the seventh part" of all lands granted, set apart under the provisions of the 1791 Constitutional Act "for the support and maintenance of a Protestant Clergy" had become a bone of contention among the various religious denominations. In addition the reserves interrupted continuity of settlement and made difficult the extension of some roads. This long-standing source of grievances and friction was removed in 1854 when the MacNab-Morin administration passed an act of secularization formally abolishing the system.

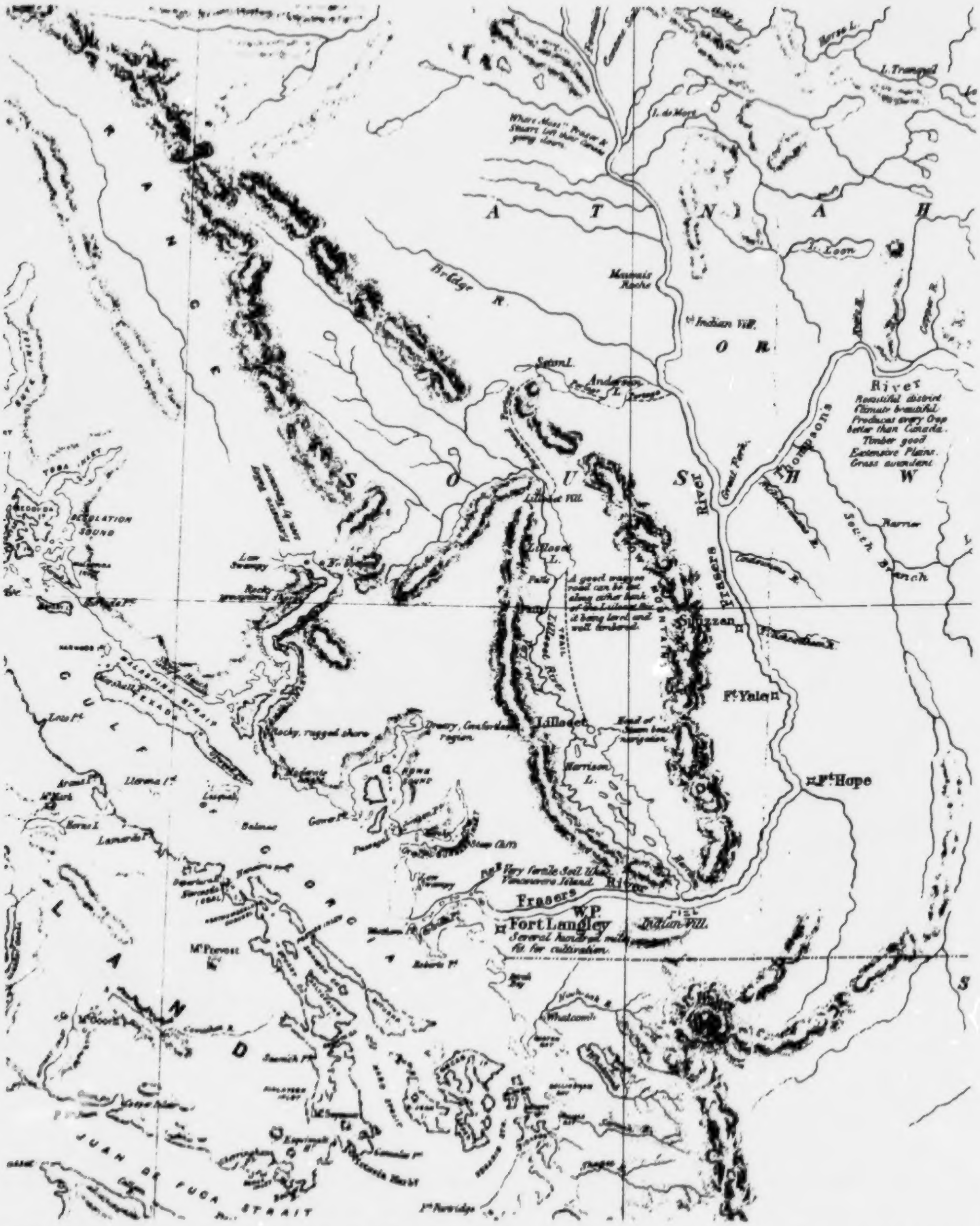
18

EARLY B.C. SURVEYS AND THE ROYAL ENGINEERS

The rugged and richly endowed region west of the Rockies in British North America was generally known among early fur traders as New Caledonia. It was a land as easy on the eye as it was hard on the feet. Unsurpassed vistas of snowy mountain peaks, gleaming alpine lakes, turbulent rivers and impressive fiords greeted the white pioneers. Augmenting the wild grandeur of the territory was the spreading, almost impenetrable, forest. One of the most eminent of the early visitors to this domain remarked in some despair after initial encounters with its jungle-like bush and timber growth, "The woods are magnificent, superb beyond description, but most vexatious to a surveyor and the first dwellers in a town".[1]

For nearly half a century after the voices of Vancouver and Mackenzie and their crews had echoed along its waterways, New Caledonia remained a relatively silent wilderness, its white occupants numbering some 50 white men employed by the Hudson's Bay Company and scattered about in a dozen or so trading posts or forts. But the combination of several apparently unrelated but powerful developments served to transform this scene in the course of the next half-century. The ceaseless search for a Northwest Passage, the commercial lure of sea-otter skins and the desire of ambitious nations to acquire new territories attracted Spanish, English, Russian and American vessels to the coast of what is now British Columbia during the 18th and 19th centuries. Alexander Mackenzie's startling success in 1793 spurred the Northwest Company to venture more boldly into regions west of the Great Divide.

During the first quarter of the 19th century the wilderness was penetrated, by use of river transport, by Thompson, Fraser, Samuel Black and John McLeod. These were the exploratory surveys, indispensable to the ultimate settlement of any new country. In the light of these achievements the Hudson's Bay Company began to increase its active interest in New Caledonia. In these expanding activities an able man of strong character


Fraser River
Fort Langley
Several hundred miles fit for cultivation.
Indian Vill.
Ft. Yale
Ft. Hope
Lillooet
Harrison L.
Bridge R.
Anderson L.
Seton L.
Lillooet Vill.
Thompsons River
Beautiful district Climate beautiful Produces every Crop better than Canada. Timber good Extensive Plains. Grass abundant.
South Branch
L. Loon
Desolation Sound
Juan de Fuca Strait
Whatcom
Esquimalt
Rocky, rugged shore
Very fertile Soil like Vancouvers Island
W.P.
Indian Vill.
Mauvais Roche
Where Mess. Fraser & Stuart left their Canoes going down.
A good waggon road can be had along either bank of the Lillooet River it being level and well timbered
Head of steam boat navigation

MAP 35. A section from a map of part of the British possessions to the west of the Rocky Mountains from surveys made by the Royal Engineers in the 1860's. Courtesy of the Public Archives of Canada.

was needed to provide leadership. We have seen how essential to the sound development of other parts of Canada were the contributions of capable governors such as Frontenac, Parr, Simcoe and Simpson. In its coastal frontier work the Hudson's Bay Company found a man in the same heroic mould, James Douglas (1803-77). Douglas was sent by the company to Vancouver Island in the summer of 1842, empowered to select a site for the new Hudson's Bay Company fort, intended as company headquarters west of the Rockies. With Douglas went Adolphus Lee Lewes, English-educated, half-breed son of Chief Factor John Lee Lewes.[2] In 1839 A. Lee Lewes had entered the company's employ as "Surveyor and Clerk for general service" and was assigned to what was then known as the Columbia Department. He arrived in 1840 and it was understood that when Lewes was not engaged in surveying he would serve as a general clerk. The extent of his training as a surveyor remains vague. The Governor and Committee of the company in London, England, had been content to state that Lewes had been "brought up in the land surveying business" and expressed the wish that he might also qualify in nautical surveying while in the Department. Lewes prepared plans of the new fort, formal approval for which was given on June 28, 1842. In the following year Fort Victoria was erected. Lewes retired from the company service in 1853 and died at Fort Vancouver in September, 1856.

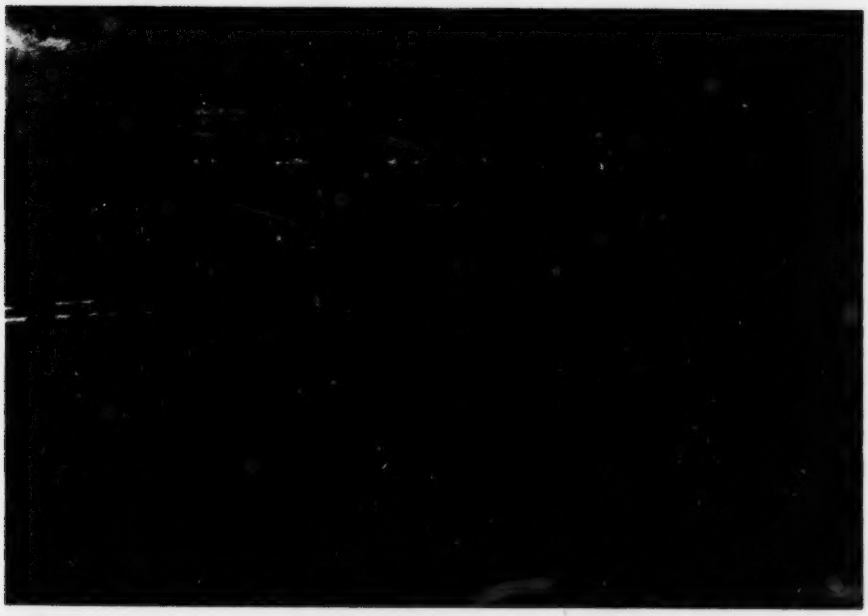


FIGURE 38. Birth of Victoria, B.C. James Douglas viewing site for Fort Victoria and Hudson's Bay trading post, Vancouver Island, 1843.

The successor to Lewes as company surveyor was Capt. Walter Colquhoun Grant (1822-61). This Edinburgh-born officer in the Royal North British Dragoons (later Royal Scots Greys) met financial reverses and, unable to maintain his army commission, resigned and emigrated to America.[3] The 26-year-old Scot was offered the post of

Hudson's Bay Company surveyor and arrived at Victoria by way of Fort Vancouver on August 11, 1849. Sir John Pelly had given him his appointment as surveyor, the salary as well as the volume of surveys to be fixed after his arrival on Vancouver Island.[4]

Apparently the salary rate was fixed at £100 a year but Grant's training in surveying proved inadequate and he was eased out of his position, resigning in March, 1850. As early as the previous September, Douglas had advised his own superiors in London, "I fear that Captain Grant has undertaken a duty which the pressing nature of his own affairs will not allow him time to attend to, he has not been able as yet to make any surveys nor can he with prudence absent himself from his establishment, until it is in a more advanced state".[5] At this time, owing to rather restrictive land settlement policies of the Hudson's Bay Company, not more than a score of settlers resided on Vancouver Island.

Mention ought to be made, at this stage, of Capt. Henry Kellett, commanding H.M.S. *Herald* and the tender *Pandora*. In 1846 he carried out hydrographic surveys off the coast of Vancouver Island. The harbors of Victoria, Esquimalt and Sooke were examined by him during the survey season. An interesting sidelight on the progress of position-finding at sea occurs in the narrative of this expedition written by Berthold

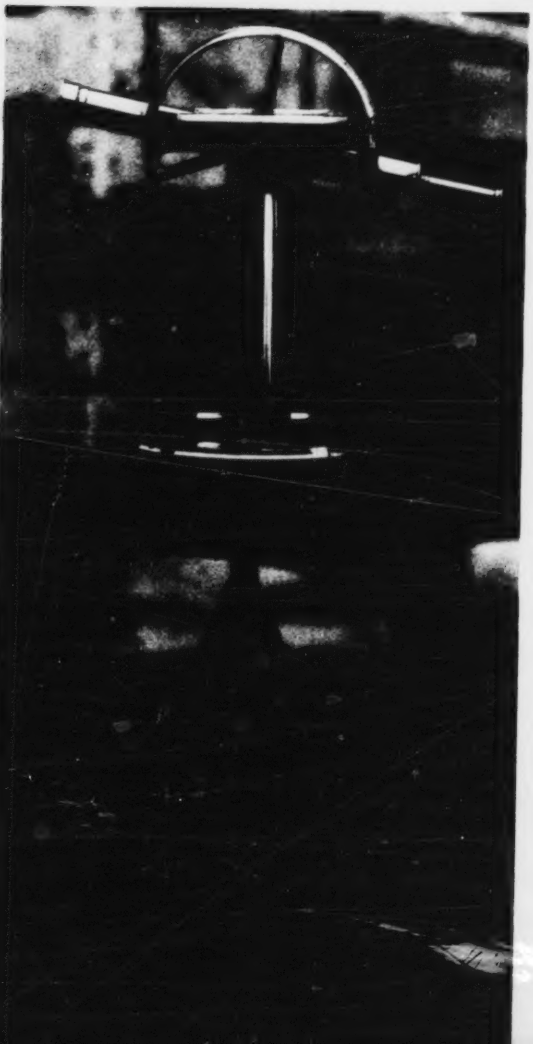


FIGURE 39
Pioneer surveying instrument used on Vancouver Island, c. 1850.

Seeman: "At daylight on [June] 24th [1846] we found ourselves off Cape Flattery rocks; and thus, after a seventy days' passage without seeing land, was our voyage concluded; yet, thanks to our admirable chronometers, we made the land within a mile, a nicety of calculation which in these days is not much to boast of, being performed by three-fourths of the vessels of England and America, as well as France and Holland; but looking back thirty or forty years, the change is immense".[6]

Douglas, in a report on a canoe expedition along the east coast of Vancouver Island in 1852, remarks that he was "struck with the extreme incorrectness of the maps of Vancouver Island". He proceeds to point out that the line of coast "is well delineated, and could be traced upon our maps as far as the promontory named Cowichin Head; but from that point all resemblance to the coast ceases. . ."[7] In view of the importance of the Nanaimo coalfields Douglas stressed the need of a survey of what he called the "Canal de Arro", a series of channels between Vancouver Island and the Gulf Islands.

Captain Grant's successor as company surveyor on Vancouver Island was Dublin-born Joseph Despard Pemberton (1821-93), an excellent draftsman and former professor of surveying, civil engineering and mathematics at the Royal Agricultural College, Cirencester, England. Appointed company surveyor by the Hudson's Bay Company on February 15, 1851, Pemberton arrived at Victoria in June of that year. This event, in effect, marked the inception of cadastral surveys of consequence on the island.

Pemberton's services were in considerable demand. This arrangement continued until 1858 when Pemberton left the service of the company. The following year he was named by royal warrant the first Surveyor General of the Crown Colony of Vancouver Island. Ten years previously the British government, considering it a wise and necessary move following the Oregon boundary settlement, had established the new colony on the island, under the auspices of the Hudson's Bay Company. The first governor of the colony, Richard Blanshard, remained little more than one year. Douglas succeeded him in 1851. Douglas, a former Nor'wester who entered the Hudson's Bay Company employ as a result of the 1821 merger, had been moved to Fort Victoria as the company's agent in the colony. In 1854 Douglas, not a man inclined to offer praise glibly, paid a substantial tribute to Pemberton and to his work. "He has given perfect satisfaction", Douglas declared, "during his residence here, and I may observe that the Compy have made a fortunate selection, and I think it will be difficult to find a person so well adapted for the situation he now so creditably fills, or who will discharge its duties with equal zeal and untiring energy".[8]

Pemberton's early years in office were marked by a lively demand for townsite surveys. In 1858 he completed the survey of Victoria and compiled an official town map. Streets were named after colonial governors, eminent navigators and their famous ships, Arctic explorers as well as after Canadian cities, lakes, rivers and other geographical features. Pemberton Point, Meadows and Portage are three features that recall the surveying achievements of this pioneer.

Pemberton's Victoria surveys involved the allotment to settlers of more or less rectangular parcels of land, with little attention given to running boundaries according to cardinal points of the compass. A highly irregular land pattern was produced with the lots varying from 12 to 840 acres, with no two lots containing the same acreage. By the end of 1858 a few thousand acres had been surveyed in the immediate vicinity of Victoria. By the end of 1860 more than 175,000 acres had been measured out.

But not all of Pemberton's surveying was performed on Vancouver Island. In August, 1858, when the mainland was being opened for settlement, Douglas despatched Pemberton on a mission to lay out new townsites at old Fort Langley, Fort Hope and

Fort Yale. His instructions were to survey as quickly as possible all open districts "so that the country may be laid out for immediate settlement and occupation".[9]

The year 1858 proved to be a turning point of key significance in the development of British Columbia. It brought swarms of newcomers to the colony, an avalanche of formative events and a multitude of administrative problems. The Crown Colony of Vancouver Island had been created in 1849, almost in a defensive frame of mind, as an entrenchment against the spread of American sovereignty. Then in the spring of 1858 the world learned of valuable placer gold finds in the Fraser River valley, as well as gold discoveries in the Cariboo districts, deep in the interior. The strange fever that grips men who have caught glimpses of an Eldorado, raced through the western and northwestern states. It was the California gold rush over again. Before the year ended more than 25,000 American gold-seekers, mostly rough and ready miners, had poured into British territory. Many of these newcomers passed through Vancouver Island's new capital. Douglas saw Victoria transformed almost overnight from a quiet, English-type village into a bustling commercial centre of increasing magnitude. The changes made by this remarkable influx on the mainland colony were even more impressive.

The invasion confronted Douglas with a cascade of harassing problems. The foundations of law and order had to be strengthened. The Governor's voluminous and urgent correspondence with authorities in London during this hectic formative period is both enlightening and eloquent in regard to the needs of the hour. Fortunately for British Columbia and for Canada the Secretary of State for the Colonies at the time was a man of stature, of imagination, ability and understanding. Sir Edward Bulwer Lytton, author of *The Last Days of Pompeii,* had succeeded to the office and was quick to perceive the gravity of the issues involved. He proceeded to take a number of wise legislative and administrative steps to meet the situation. He piloted through the Commons at Westminster a bill to establish on the mainland a new Crown Colony. The bill, as printed for first reading, employed the name "New Caledonia" but before the measure passed Parliament on August 2, 1858, Queen Victoria had bestowed upon the embryo colony the proud title of "British Columbia".

Next, Lytton approached Douglas to agree to become Governor of the mainland colony, as well as of Vancouver Island, on the condition that he sever his connections with the Hudson's Bay Company. Douglas (knighted in 1863 in recognition of his invaluable public service) was sworn in at Fort Langley on November 19, 1858, regarded by some as the official birthday of British Columbia.

In order to provide reliable land surveys as well as townsites essential to permanent settlement and to curb lawless elements, Lytton persuaded the British government to send a detachment of Royal Engineers to the aid of the hard-pressed Douglas administration. In July Lytton wrote to Douglas: "I have to inform you that Her Majesty's Government propose sending to British Columbia, by the earliest opportunity, an officer of Royal Engineers [probably a Field Officer with two or three subalterns], and a company of Sappers and Miners, made up to 150 non-commissioned officers and men".[10] Lytton kept his word. The detachment that arrived in three sections actually totalled 165. Two sections came by way of Panama overland to the Pacific; the third and largest, by way of Cape Horn travelled 15,000 miles in the space of 184 days.

The Crown Colony office of Chief Commissioner of Lands and Works was set up by British authorities and Col. Richard Clement Moody (1813-87) was selected not only to command the Royal Engineers detachment but to fill the role of Commissioner in addition to holding the dormant commission of Lieutenant Governor of the mainland colony. The military unit was not merely one of the 40 regular companies into which the Royal

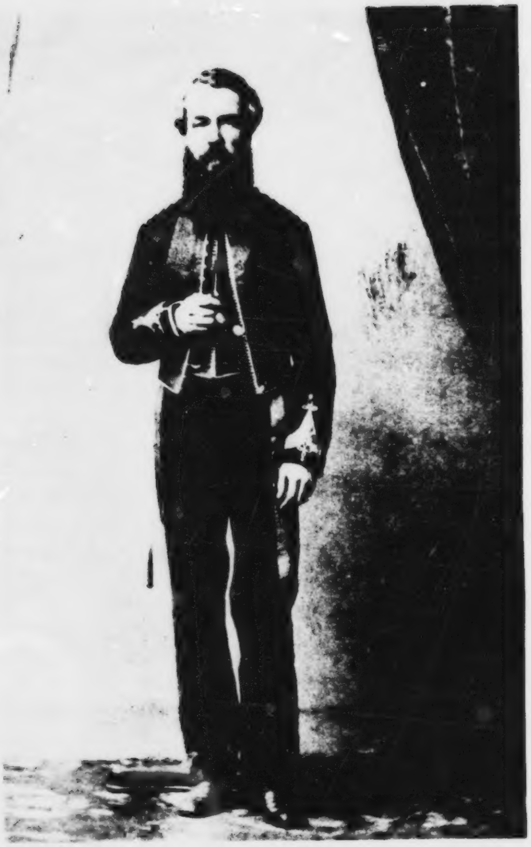


FIGURE 40
Col. Richard Clement Moody, R.E.

Engineers was then divided. It was a specially picked body of men. Of the two sections that came out by way of Panama, the one headed by Capt. R. M. Parsons consisted of 20 men, mainly land surveyors; the other, headed by Capt. J. M. Grant, consisted of 12 men, mainly carpenters. The third section of some 120 sailed on the *Thames City* and was commanded by Capt. H. R. Luard. Col. Moody made the 57-day journey by way of Panama. In addition to the officers mentioned he was to receive important support from such other commissioned and non-commissioned men as Lieut. Henry Spencer Palmer, Lieut. A. R. Lempriere, Sergeant-Major George Cann, Sergeants William McColl and Richard Bridgeman, Lance-Corporal George Turner and Sapper J. B. Launders.* All of these soldiers took part in carrying out the basic surveys under the instructions of Col. Moody.

The assignment given the Royal Engineers detachment was a grim and challenging one. The new British American colonies washed by the Pacific were remote from any large centres of population in North America. Two thousand miles separated Upper

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*McColl, Turner and Launders became civilian surveyors after 1863. Turner became a charter member of the B.C. Association of Provincial Land Surveyors, founded in 1891.

Canada from British Columbia with the exception of the tiny Red River settlements. To the west stretched the world's widest ocean. To the north lay a vast wilderness. The topography and geography of the Far West combined to frustrate governments, impede settlement and baffle surveyors. There were formidable difficulties involved in transporting delicate surveying instruments over hilly and heavily wooded country. "The thickets", remarked Moody in a report, "are the closest and thorniest I ever came across" and Palmer, struggling valiantly through the interior complained that he had outstripped the sufferings of St. Paul.[11]

In the face of such conditions the record of solid accomplishments made by the Royal Engineers on the West Coast commands admiration, if not a form of reverence. Men of the Royal Engineers had already taken a prominent and helpful part in other Canadian survey projects, such as those connected with the construction of the Rideau Canal and in the fixing of the Canada-United States boundary. The Moody contingent fully lived up to the high surveying and mapping traditions established by their regimental predecessors. Officers and men, during their 5-year sojourn in British Columbia, ran its first meridian line, the Coast Meridian; performed important exploratory surveys; surveyed for cadastral purposes the peninsula between Burrard Inlet and the Fraser River; laid out the townsites of the principal communities of the mainland colony; located and constructed lines of all main roads required in their time; drafted and constructed all maps resulting from their numerous surveys, then lithographed and published them; formed British Columbia's first building society; designed its first church and schoolhouse; its first municipal coat of arms and its first postage stamp issue; its first observatory and first systematic meteorological observations. They organized its first Lands and Works Department, its first printing office, publishing the British Columbia *Gazette*. Last but not least, the unit helped to maintain law and order under circumstances not always conducive to that condition.[12]

Political cross-currents and personality clashes complicated tasks already onerous. The manly effort made by Douglas to serve impartially the interests of civil government on the one hand, and of the Hudson's Bay Company on the other, placed him under heavy strains. Lytton was biased against the Company and this attitude did little to alleviate the stresses already keenly felt by Douglas. The Governor was among the few who realized that the 1858 gold rush spelled out the end of the Company's trading monopoly in the Far West. Although at the outset of Royal Engineers' activities in the colony Douglas expressed official satisfaction over Moody and his administration, in time the relationship soured and this unhappy development also added to the Governor's heavy burdens. In a moment of exasperation Douglas declared that the Royal Engineers had become to British Columbia "what the old man of the sea was to Sinbad. . ."[13]

At the root of most, but not all, of the friction that developed in this situation were the well-nigh insoluable fiscal problems confronting Douglas. Lytton made it plain that the new colony was expected to pay its own way from funds derived mainly from the sale to settlers of Crown lands. The Royal Engineers were to receive colonial pay from the Colony administration, the regular regimental pay to be forwarded from England. The cost of land surveys, in practice, dismayed Douglas. By the end of 1859 that cost had exceeded $15,000.

Actually the amounts derived from land sales fell far short of expectations. By 1870 this form of income constituted only one-fortieth of the total revenue of the colony. During the colonial period, revenues gained from the sale of surveyed land and town lots proved insignificant compared to sums produced from customs duties and road tolls. Considerable official reluctance was shown over the payment of some of the expenses of surveys performed by the Royal Engineers. Judge Matthew Baillie Begbie, for example, lamented in a letter to Douglas in the spring of 1860 that surveyors had "marked and trenched nothing but town lots and suburban lots, in four localities of the colony — New Westminster, Douglas, Fort Hope and Fort Yale".[14] It was about this time that Douglas threatened to terminate the duties of the Royal Engineers if heavy bills such as those arising from the Fort Hope survey project continued to come in for payment. To add to his frustrations Douglas experienced constant delays and evasions in obtaining accounts of expenditure from Col. Moody's friend, Capt. Gosset, Treasurer of the Colony, who was also in charge of the commissariat of the Royal Engineers!

The reverse side of the coin presented an equally distressing picture. With expenses severely curtailed the plight of the Royal Engineers surveyor in the field became acute. Palmer, for example, travelling from Bella Coola River to the Fraser River, requested instructions from Moody as to "whether I am to stop work when the £350 is finished, or go on. I scarcely think I shall be able to do all the work that is laid down, either in the season or within the £350".[15]

Col. Moody replied to the Governor's complaints over expenditures with demands for more instruments. "It is obvious", he reported, "that without sufficient Instruments the progress of the survey of allotments in this wooded region, so thickly entangled with under-brush, must be extremely slow".[16] At this stage there were 16 Royal Engineers employed on survey duties. Of this total, five were on land registration work, taking meteorological observations, on plotting and drawing work, or on the felling of trees. Two were at Fort Hope, assisted by two civilian axemen or chainmen. The remaining 9 were in two groups, occupied in surveying suburban or rural properties near New Westminster, without civilian aid. As this small survey organization was also part of a military unit, camp duties frequently interrupted surveying work, both in regard to its accuracy and general rate of progress.

Douglas had differences with Moody on other important points. Although he consented to the Colonel's preference of New Westminster as the capital of the mainland colony, he was not happy over the transfer of the seat of government from his own choice, old Fort Langley, in February, 1859. Before Moody's arrival in the colony Douglas had, in all good faith, instructed Pemberton of Vancouver Island to survey old Fort Langley townsite and to conduct an auction sale of its lots. The subsequent abandonment of the town as the colony's capital, even after adjustments in regard to land purchases had been made, left a heritage of political grievances, Douglas bearing the brunt of these burdens.

There were disagreements also between Douglas and Moody over priorities to be accorded road surveys and construction as against property and townsite surveys. From the outset of his administration Douglas considered road construction to be one of the first objectives of government.[17] He was fully aware of the fact that gold miners in the interior were paying famine prices for provisions and that road links with the coast would alleviate much hardship and prevent civil troubles. However, Moody had his instructions direct from Downing Street to "regard with a military eye the best positions for such towns and cities, as well as for the engineering of roads and passes, or laying the foundations of any public works".[18]

Even as early as July, 1858, there was public clamor over the fact that no public rural land had been placed on the market by the government. The surveys of these lands had been postponed while the townsite of Queensborough (later New Westminster) was being laid out.

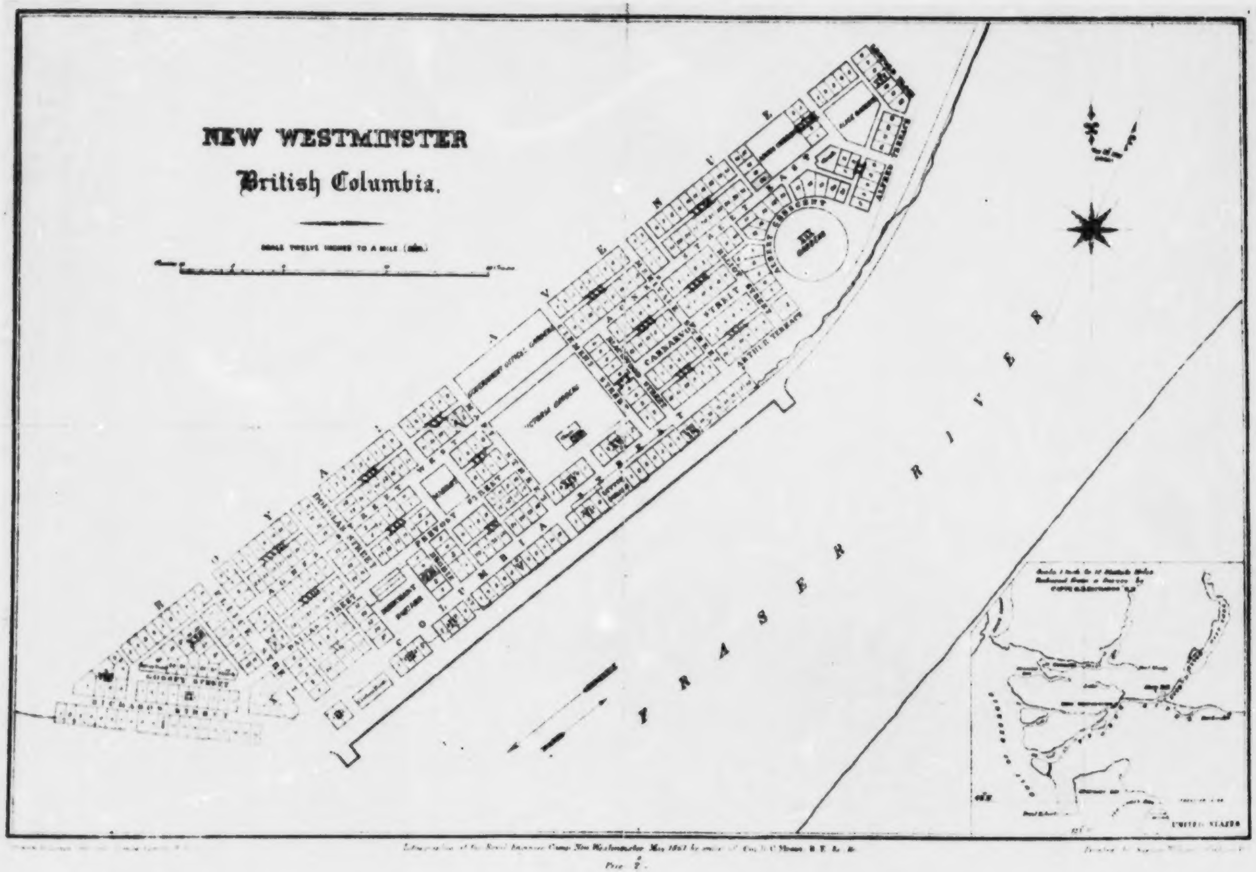
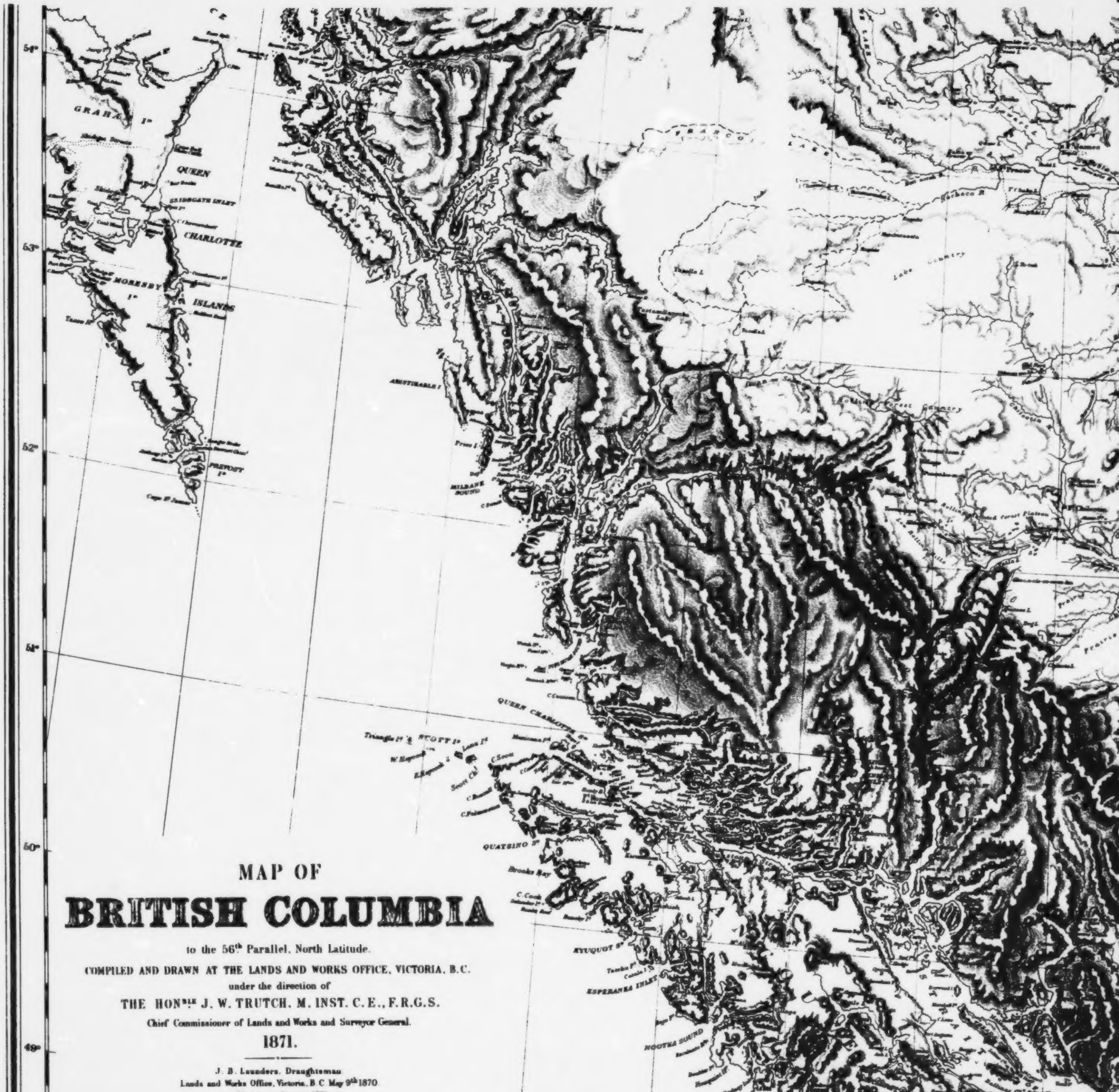
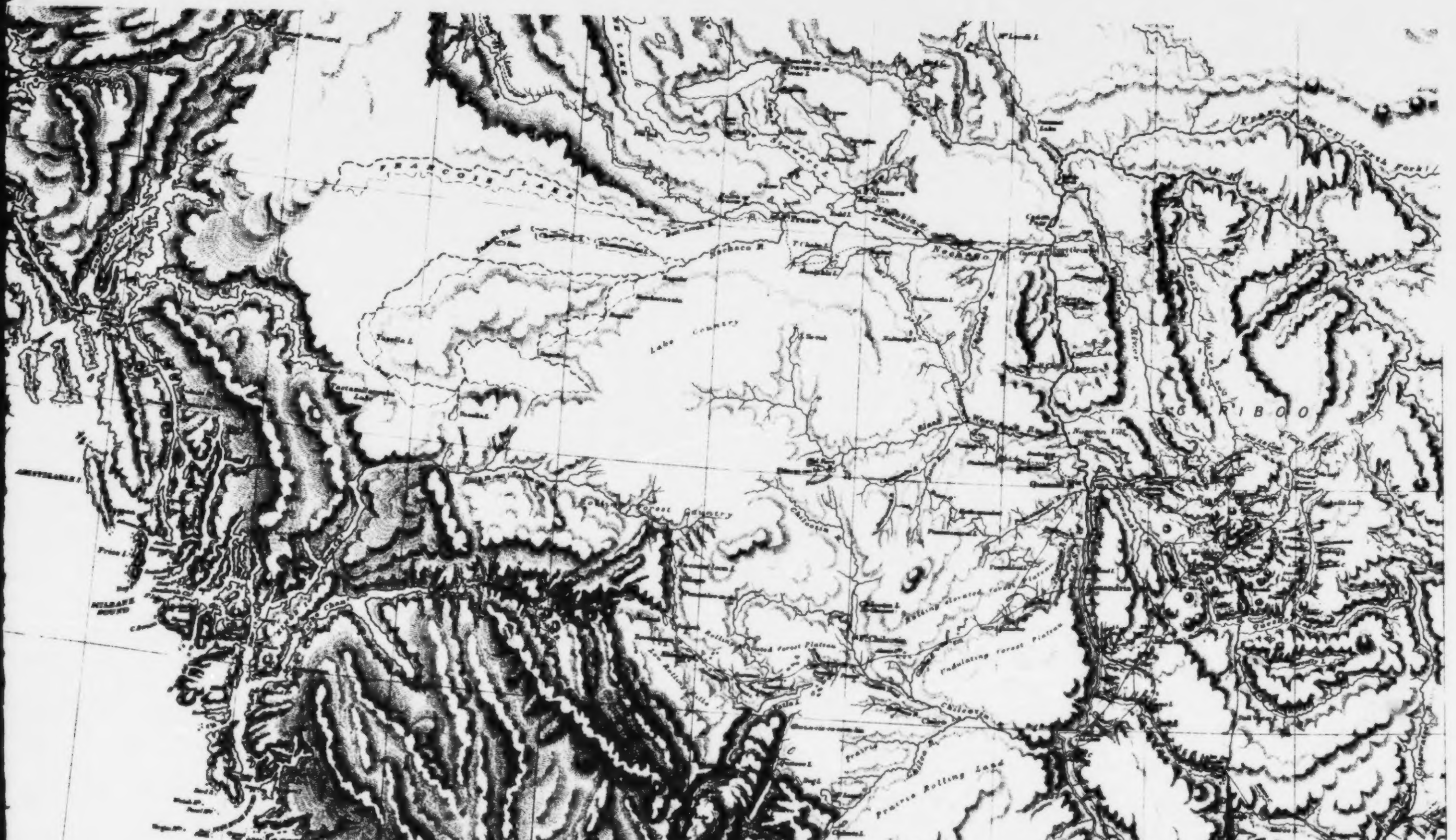

NEW WESTMINSTER
British Columbia.
ROYAL AVENUE
CARNARVON STREET
FRASER RIVER

FIGURE 41. Townsite plan of New Westminster, drawn and lithographed at the Royal Engineers' camp nearby, with inset showing lower mainland area of B.C.


MAP OF
BRITISH COLUMBIA
to the 56th Parallel, North Latitude.
COMPILED AND DRAWN AT THE LANDS AND WORKS OFFICE, VICTORIA, B.C.
under the direction of
THE HONBLE J. W. TRUTCH, M. INST. C.E., F.R.G.S.
Chief Commissioner of Lands and Works and Surveyor General.
1871.
J. B. Launders, Draughtsman
Lands and Works Office, Victoria, B.C. May 9th 1870.
additions to January 1871.
Scale. 1/1,584,000 or 25 English Statute Miles to 1 Inch
0
10
20
30
40
50
60
70
80
90
100
54°
53°
52°
51°
50°
49°
GRAHAM Id
QUEEN
SKIDEGATE INLET
CHARLOTTE
MORESBY Id
ISLANDS
PREVOST Id
ARISTIZABLE I.
MILBANK SOUND
QUEEN CHARLOTTE Sd
SCOTT Is
Triangle Id
Scott Ch.
QUATSINO Sd
Brooks Bay
KYUQUOT Sd
ESPERANZA INLET
NOOTKA SOUND
CLAYOQUOT Sd
Lake Country

MAP 36. Courtesy of the Public Archives of Canada.


FRANCOIS LAKE
Nechaco R.
Lake Country
CARIBOO
Chilcotin
Rolling Wooded Forest Plateau
Undulating Forest Plateau
Prairie Rolling Land
MILBANK SOUND
QUEEN CHARLOTTE Sd
SCOTT Is
QUATSINO Sd
MBIA
VICTORIA, B.C.
F.R.G.S.
KYUQUOT Sd
ESPERANZA INLET
NOOTKA SOUND
CLAYOQUOT Sd

MAP 36. Courtesy of the Public Archives of Canada.

Because of increasing financial stringency Douglas had to refuse Moody's request that one Joseph William Trutch be added to his staff of surveyors. In this action Douglas, quite unwittingly, may have performed a valuable service for Trutch, the English-born son of a solicitor, trained as a civil engineer, who proceeded to carve out a remarkable career for himself in the colony as a civilian contractor. He became the first Surveyor General of the United Colony of British Columbia (1866-71) and then the first post-Confederation Lieutenant Governor of the province of British Columbia (1871-76) before being knighted by the Queen in 1889.

In the meantime foundations were being laid for future enactments on the subject of surveying in British Columbia. On January 4, 1860, Governor Douglas issued a proclamation declaring that any piece of land to be acquired by pre-emption (the right of purchasing before others) should be in rectangular form with the shortest side at least two-thirds of the longest side. By further proclamation dated January 19, 1861, it was provided that property boundaries should run as nearly as possible by the cardinal points of the compass. Vacant fractions up to 160 acres, enclosed by prior locations could be acquired notwithstanding any irregularity of shape. The Chief Commissioner of Lands and Works (Moody) was empowered to appoint 'Sworn Surveyors', ". . . and shall also acquire from each of them security to the value of £100 that they will well and efficiently survey such piece of land as they may be required to survey". Any purchaser of land could apply to the Chief Commissioner to appoint a Sworn Surveyor to survey the land at the expense of the applicant.

In 1859 the Royal Engineers had run the Coast Meridian line from the 49th parallel to Burrard Inlet, over a relatively level plain. The mountainous terrain north of the inlet probably discouraged any extension of the meridian. But every three miles along the established line was called a Block North. At a point 12 miles north of the point of beginning, a line was run west setting off ranges three miles wide, named Ranges West. The numbering of the 160-acre sections was from 1 to 36, starting in the northeast corner and proceeding west then returning east, similar to the U.S. system in the State of Washington. This rather small area near New Westminster is the only area in British Columbia where this system was applied. This pattern represents the third of nine land survey systems to be instituted in British Columbia over the years since its birth. The first system was that of the irregular lots in the Victoria area (1851-58) already described. The second system involved the laying out of sections 20 chains by 50 chains in districts tributary to Victoria.

Most of the survey lines laid down by the Royal Engineers were run with a compass. Not until 1879 were instruments apart from the magnetic needle used. Civilian surveyors were less careful than the engineers. For example, a surveyor of fairly recent times has reported that "on the north boundary of Township 12 I traced quite a distance on a flat through hardback and then got on a side hill. On looking back over the line, I saw the bend at every quarter section post. I suppose that the original Surveyor when he got to that point looked back, and when he saw how crooked his line was, he just wrote [in] his notes, 'Strong local attraction here', and continued on his line without going back to correct [the situation]."[19] In contrast to those conditions another surveyor of recent times reports that "in the Fraser Valley and around Victoria pioneer surveys . . . made by the Royal Engineers [using the] magnetic needle on the transit for starting lines [and] a variation which had been determined at the observatory [Sapperton . . . left me with a] high opinion of the [early] work . . .".[20]

Although military men dominated the highly active survey and road construction period, 1858-63, the Douglas and Moody projects benefitted from the contributory efforts of three able and highly resourceful civilians. Each was a civil engineer and each became a practising land and highways surveyor. J. W. Trutch, already mentioned, Edgar Dewdney (1835-1916) and Walter Moberly (1832-1915) assisted the Royal Engineers in opening up new country. Two of the three, Trutch and Dewdney, later became lieutenant governors of British Columbia. Dewdney and Moberly, as new arrivals in the Pacific Northwest, were employed by Moody in 1859 on the work of laying out the townsite of Queensborough (New Westminster). In time Moberly became an author and his first book *The Rocks and Rivers of British Columbia*, published in 1885, was dedicated to Col. Moody. Moberly had come from Upper Canada to conduct an exploratory survey, at his own expense, in search of a mountain pass through the Rockies affording passage to a trans-continental railway. He worked with military labor in the construction of the Cariboo wagon road and his advice in later years guided the Canadian Pacific in the selection of its mountain route. Both Moberly and Dewdney entered public life in the province, the former being elected to represent Cariboo West in the Legislative Council and the latter, Kootenay district in the provincial Legislature. Dewdney was named Lieutenant Governor of the Northwest Territories in 1881, serving in that capacity until 1888. He was an important moderating influence during the 1885 uprising on the prairies. Before he became Lieutenant Governor of British Columbia in 1892, Dewdney was Minister of the Interior in the cabinet of Sir John A. Macdonald.

Road surveys and road construction were carried on by the Royal Engineers in 1859. Both Lieut. Palmer and Lieut. Lempriere were active in conducting preliminary surveys. A trail was cut that year from New Westminster to Burrard Inlet along a line which, two years later, was followed by the Royal Engineers in building the North Road. In the summer of 1860 Sergeant McColl led a party in locating a route for the Hope-Similkameen Trail, carrying the line over a 4,000-foot elevation with a gradient no greater than one foot in twelve. This became known as the Dewdney Trail after the man who was largely responsible for its construction. Sergeant-Major Cann and a detachment of Royal Engineers in 1860 excavated a mountain near Yale so that a roadway could be built. Similarly Sergeant Bridgeman and a party conquered Gibraltar Hill with a brilliant display of engineering techniques in 1861. In the same year Capt. Grant and 80 men started construction of the Hope-Similkameen Road and the Royal Engineers made a reconnaissance survey of the difficult terrain between Yale and Lytton. Sergeant McColl and a party selected a place for the crossing of the Fraser Canyon, finally accomplished by the erection of the Alexandra Suspension Bridge built by J. W. Trutch and completed in 1863.

Various alternative road routes were being advocated through the interior and to help decide the issue Lieut. Palmer was sent to conduct a survey from the head of North Bentinck Arm to Alexander and Williams Creek. Palmer's report and maps constitute an important contribution to the survey and cartographical literature of British Columbia. His was the first recorded effort since the exploratory survey of Alexander Mackenzie to map a route across the Chilcotin Plateau. Palmer was highly enthusiastic over the boat journey of 440 miles from Victoria to the point of beginning of his survey. He was persuaded that the trip afforded "the most wonderful inland navigation in the world . . . through an archipelago of surpassing beauty". The Arm, which was the inlet reached by Mackenzie in 1793, was about 25 miles long. He began his exploratory survey up the valley with one other officer, two sappers, a packer and 8 horses. After four months his conclusions were succinctly worded: ". . . My own impression is that . . . the [North] Bentinck Arm route is, from its high continuous elevation, and from the general absence of good soil and pasturage in the districts which it traverses, unlikely . . . to acquire importance as an arterial highway to the established gold mines of this country".[21]

Palmer's findings made it clear that the Cariboo Road project had been wisely chosen as the best highway route from tidewater to the interior. In 1863 military engineers under Capt. Grant located the Cariboo Road from Clinton to Alexander (named after Mackenzie) and selected the route to Williams Creek. More than 63 miles of new road were built under his direction that season. They bequeathed to the new colony a well-engineered, soundly-constructed road that effectively solved Governor Douglas' problem of establishing communication with interior settlements. It may be justly said as well that the Royal Engineers left a notable heritage of survey plans and map sheets, work that laid the foundations for the future systematic mapping of British Columbia.

Restless miners had spread over a wide region. Minor gold rushes to Rock Creek in the Similkameen country, to Wild Horse Creek in the Kootenay and to the Big Bend district of the Columbia had taken place and eventually the precious metal was discovered as far north as the Stikine, Nass and Peace rivers. It was financially, if not administratively impossible to govern such an immense area under the two-colony set-up. Unification was inevitable and on November 19, 1866, the Crown Colony of Van-

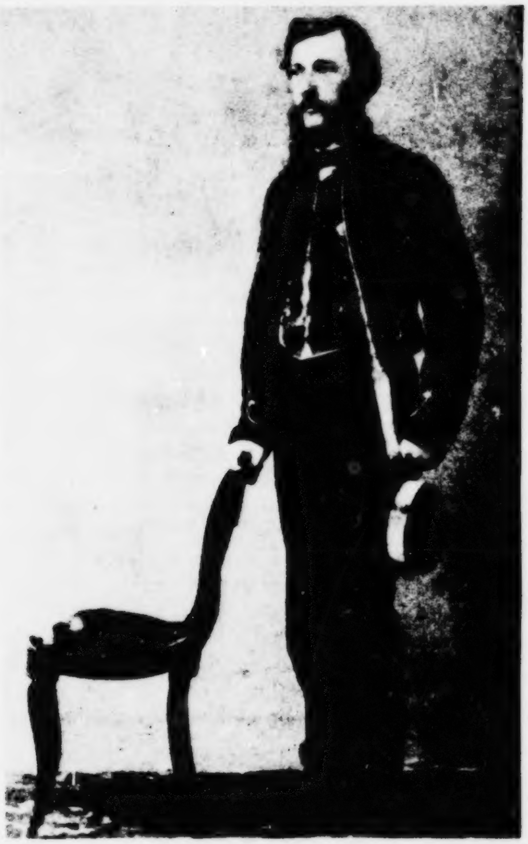


FIGURE 42
Lieut. Henry Spencer Palmer, R.E.

FIGURE 43. The Cariboo Road. In 1862 surveyors of the Royal Engineers helped make possible the bridging of many formidable chasms in the Fraser River Canyon.

couver Island merged with the mainland colony to become the United Colony of British Columbia.

Among their achievements the Royal Engineers had established an observatory at their Sapperton camp outside New Westminster, fixing its position at 49 degrees, 12 minutes, 47 seconds north latitude and 122 degrees, 53 minutes, 19 seconds west longitude. The transit used in making this observation, as well as many others, is now in the British Columbia Archives. On January 23, 1863, a party of the Royal Engineers under Lance-Corporal George Turner was ordered by Moody "... to lay out claims or survey lands (160 acres each), narrow side to shore front" on the present site of Vancouver, constituting the first property surveys, on lots 184 to 187 inclusive in that city. The party also made a complete traverse of the shoreline from Hastings townsite around the peninsula now known as Stanley Park into English Bay and up False Creek.

In April, 1863, the Municipal Council of the City of New Westminster passed a resolution: "That in consequence of the judicious selection of the townsite of New Westminster for the capital of British Columbia by Colonel Moody, R.E., this Council considers it desirable that a space of not less than 20 acres should be reserved in the suburbs not being surveyed, to be called Moody Square in commemoration of the founder of the city". Port Moody and several natural features of the coast province have been named in honor of this dedicated and enterprising soldier who, by his leadership and with his men, made an enduring contribution to the upbuilding of British Columbia. Stanley Park, in a real sense, is a memorial also to Col. Moody who set aside as a military reserve 354 acres of that peninsula on the south side of the First Narrows at the entrance to Vancouver Harbor. In addition to their sterling work on pioneer roads to the interior the Royal Engineers laid out townsites of New Westminster, Lytton, Lillooet, Clinton, Quesnel, Richfield, Hope, Yale and Douglas as well as making a beginning on cadastral surveys within what was to become the townsite of Vancouver.

On July 8, 1863, an order from London for the recall of the Royal Engineers was announced on regimental parade. A large number of men, on being given the option to do so, remained in British Columbia. Each qualified man received a free grant of 150 acres. A few men were retained in such local government posts as printers and customs officers. Others found work as civilian surveyors, architects, carpenters, masons and in a variety of other occupations. Married men were permitted to occupy the houses in which they had been living. The valuable library donated by Sir Edward Bullwer Lytton to the unit was handed on for the use of those men who took their discharge and remained to take up new lives in the young colony.

At a complimentary dinner tendered at the Colonial Hotel, New Westminster, November 5, 1863, the Colonel responded to the toast to the commander and officers of the Royal Engineers detachment. He replied with military brevity, "It was an experiment, gentlemen, a novelty, mingling thus military and civilian duties. How far it has met what was sought for by the Government, is not for me to say. I ever, as was natural, and as was my duty, kept the military part foremost in my mind, and it is with feelings of extreme satisfaction I can reflect on that part of our service in British Columbia. You have been witnesses throughout of our discipline, and at the same time how we, — soldiers — have borne ourselves in our social relations with you. Some anxiety was felt on the probable result of this part of the experiment. I had no fear. I had full confidence from the beginning in the class of men I had the honour to command. I knew what they were; I knew well how they would act, and in this I have not been mistaken. . . . For myself, my functions as Chief Commissioner of Lands and Works will cease when I embark for England, but from that moment I can be, and I shall be, more truly a British Columbian than ever".[22]

This gallant leader departed in the steamer *Enterprise* never to return to Canadian shores as he hoped that he could. One hour later H.M.S. *Cameleon* with Dr. Seddall, Lieut. Palmer and bride as well as 15 sappers, sailed past the Pioneer Wharf that served the town. As the vessel sailed one hundred of His Majesty's sailors gave three rousing cheers. This demonstration brought a similar response from the large crowd on shore while the Royal Engineers' brass band played popular songs of farewell. There was a flurry of unseemly political scuffling over the appointment of a successor to the commissionership. Douglas wished to appoint Capt. Luard. But for some obscure reason this plan collapsed. In 1864 J. W. Trutch was appointed the first Surveyor General of the mainland colony and in 1866 became the first Surveyor General of the United Colony of British Columbia.

19

THE GEOLOGICAL SURVEY OF CANADA: THE FIRST QUARTER-CENTURY

"And time, that takes survey of all the world, must have a stop."
King Henry IV (1), Act 5, Sc. 4.

By the beginning of the 1840s Canadians stood at the portal of an era of political resurgence and economic growth. The French-speaking community of Lower Canada had acquired a fair measure of stability. Other provinces of British North America were developing distinctive characteristics. Population had reached 1.4 million. Following abortive uprisings in Upper and Lower Canada in 1837, Lord Durham proposed legislative union as a promising solution of political difficulties and, as a result, the new united Province of Canada was established by the Act of Union (3-4 Vic. ch. 35). Kingston became the capital of the combined colonies.

Land surveys, road-building and canal construction had grown apace in this large central region of British North America. There was increased talk of railway-building on an ambitious scale. A ferment of thought and activity permeated a variety of economic and public-spirited pursuits. In Canada West, as Upper Canada became officially known after union, District Councils were authorized to construct new roads and to maintain existing highways. In 1841 (4-5 Vic. ch. 9) penalties were imposed upon anyone who interfered with the work of land surveyors. Licensed surveyors were authorized to administer oaths. In Canada East (Lower Canada) the union of provinces brought about the disappearance of the title of Surveyor General in that jurisdiction.

The year 1842, in particular, was characterized by wise planning, sensible action and vision. Queen's University, founded the previous year, began holding classes in 1842. Admiral Bayfield moved the headquarters of his Canadian hydrographic surveys to

Charlottetown. The Webster-Ashburton treaty had settled long-standing boundary differences and dispelled the clouds of international hostility. It was the year of the birth of the composer (Calixa Lavallée) of "O Canada"; the year when J. S. Dennis Sr., was admitted to the practice of land surveying in Canada West; when J. G. Boulton, destined to become a noted Great Lakes hydrographer, was born in England; the year of the (Robert) Baldwin-(Louis) Lafontaine ministry, the first to face the newly-constituted provincial parliament and it was the year of the appointment of William E. Logan (1798-1875) as Provincial Geologist, a man of singular merit who was to become the first Director of the Geological Survey of Canada.

It is not within the purview of this history to trace the whole of the growth of the Geological Survey of Canada over the years since its establishment. That development is of such monumental character and on such a massive scale as to demand a definitive history of its own. This history is concerned, however, with Canadian geological surveying to the extent that our earliest professional geologists found it necessary to undertake topographical mapping of their own. The story of the beginnings of the Geological Survey in this country is largely that of one man. Not that Logan was without capable assistants. Yet he remained the guiding and moving spirit of the organization and by far its most prodigious worker and most generous benefactor. Alexander Murray, later to be awarded the C.M.G., was Assistant Provincial Geologist from the first. Almost from the outset Logan had the devoted help of James Richardson, a Beauharnois farmer and of James Lowe, a Grenville township farmer, enthusiasts who became trained in the work as it proceeded. Other staff members included a chemist, De Rottermond, and a provincial land surveyor, J. De Cew. These two men served for relatively brief periods. T. Sperry Hunt (1826-1892) was recruited early in 1847 as a chemist and mineralogist. Later on Robert Bell, a young civil engineer, joined the Survey. He first came in contact with the organization at the age of 15 as a helper in the Richardson field party in the Gaspé. Robert Barlow and his son Scott were also active as topographers and draftsmen.

In the Province of Canada the need for a geological survey organization was being acutely felt. A scattering of unrelated but scholarly papers had been written in Canada on aspects of local geology and some significant collections of minerals had been made. But no systematic or comprehensive geological studies had been undertaken. Almost nothing was known of the various rock formations of Canada and their distribution. In January, 1832, a Dr. Rae petitioned the parliament of Upper Canada for financial assistance to conduct a geological survey. His request, although supported by Lieut.-Governor Sir John Colborne, was rejected by the committee of supply. In December of the same year a petition was submitted by the York Library and Philosophical Society for a government grant to provide for an investigation of the geology, mineralogy and natural history of the province. In 1836, on a motion made by W. L. Mackenzie, a committee was named by the house to report upon a plan for a geological survey. A report was printed but no other action taken. Other moves, all abortive, were made, including an effort by R. G. Dunlop, a member of the house, to obtain a grant of wild lands to help defray the cost of a geological survey.

Under the new Governor General, Lord Sydenham, progress was made in the matter. In the first (united) parliament of 1841 the Natural History Society of Montreal and the Literary and Historical Society of Quebec petitioned for fiscal aid in order that a geological survey could be carried out. Hon. S. B. Harrison moved that £1,500 sterling be included in the estimates for such a purpose. This motion carried. The ill-fated Sydenham, whose death followed a fall from his horse in September, 1841, was succeeded by Sir Charles Bagot. It became Bagot's responsibility to name a provincial geologist. Bagot consulted with Lord Stanley, then Secretary of State for the Colonies, and as a consequence Canadian-born William Logan was appointed in the spring of 1842 to make a geological survey of the Province of Canada.

The selection of Logan was far from being a shot in the dark. William Edmond Logan was born in Montreal of Scottish parents on April 20, 1798, the year in which the death penalty was applied in Upper Canada for tampering with or destroying property boundary markers. William Logan, the father, was a well-to-do merchant. He sent this third child of a family of nine to Edinburgh High School in Scotland. That was in 1814, when Napoleon was exiled to Elba and when hostilities between Canada and the United States came to an end. From 1815 to 1827 Logan worked in a large London counting house. During this period, while on holidays, he climbed Ben Nevis (4,406 feet), the highest mountain in the British Isles. "Never did I endure such dreadful fatigue as I experienced in ascending and descending this great mountain". At 29 years of age he could not have foreseen that, in time, Canada's highest mountain (Mount Logan, 19,850 feet) would be named in his honor as a result of his contributions as a geological surveyor to the advancement of his native land.

Surprisingly enough, it was not until he was 35 years of age that Logan first revealed his keen interest in matters geological. By this time he had been in South Wales for two years, near Swansea, where he was employed at the Forest Copper Works. "The study of ores of copper", he wrote in a letter to his brother James in Montreal in June, 1833, "has gradually led me to that of mineralogy and geology and of specimens in both departments. I have become a bit of a collector. Now if you could assist me to a few of Canadian origin I should be obliged".

Logan, at this time, purchased at his own expense a theodolite, compass and other

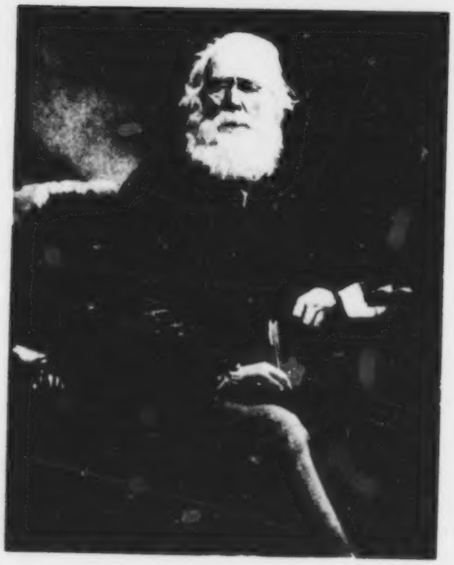


FIGURE 44
Sir William E. Logan.

surveying instruments to enable him to produce a geological map of the Welsh district in which he worked. It was this splendidly executed map that (Sir) Henry De la Beche used for the purposes of the British Ordnance Survey of which he was the director. Logan's fondness for geology increased daily and soon his work attracted attention in high places. In 1837 he was made a Fellow of the Geological Society. In 1837 he wrote to James "If I ever return to Canada, I'll geologize there".

Logan was in Canada during the winter of 1840-41 and, after examining a landslide near Montreal, wrote a learned paper for the Geological Society in London. The paper revealed Logan to be a careful, accurate observer who possessed a marked ability to express his conclusions in clear, concise prose. Before he returned to England, Logan visited Windsor, Nova Scotia, where he examined gypsum deposits with Judge Thomas C. Haliburton whom Logan considered "not deep in the mysteries of stratification". It was on this 1841 visit, during an examination of the Pictou coalfields, that Logan met the 23-year-old Dr. William Dawson, a geologist from Edinburgh University who was just beginning field research in Nova Scotia. Friendship between Logan and Dawson grew, as did their professional cooperation. It was a relationship from which Canada was to derive very substantial scientific benefits.

When Lord Stanley, through his Under-Secretary, G. W. Hope, M.P., received strong recommendations in support of Logan from De la Beche, the matter was as good as settled. "... I consider W. E. Logan perfectly equal for the task... His sections [profiles] are all levelled and measured carefully with proper instruments and his map executed with a precision only as yet employed except in his case, on the Ordnance Geological Survey... I would further observe that Mr. Logan is highly qualified as a miner and metallurgist to point out the applications of geology to the useful purposes of life, *an object of the highest importance in a country like Canada,* the mineral wealth of which is now so little known". (author's italics) (Sir) Roderick I. Murchison, President of the Geological Society of London, England, was equally laudatory.

Logan's name was conveyed to Bagot and in August, 1842, following his preliminary appointment as provincial geologist, Logan arrived at Kingston, the seat of government. An Order in Council passed by the Committee of the Executive Council on April 18, 1843, formally confirmed Logan's appointment and its text is enlightening on the conditions of his employment and the confidence reposed in him. The question of an assistant for Logan arose early in the discussion with officials in Kingston. Alexander Murray, also recommended by De la Beche, was chosen for the post.

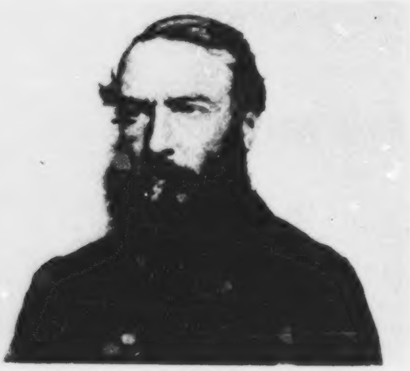


FIGURE 45
Alexander Murray.

With the adoption of the Harrison motion and with the appointments of Logan and Murray, there came into being the senior scientific organization of the federal public service of Canada. In fact, looking back now over its unbroken record of constructive activities, the Geological Survey of this country was one of the earliest of its kind to appear anywhere in the world. The birth of the Survey is commonly regarded as the year in which Logan was named its head (1842), rather than the year in which public funds were first appropriated for its purposes (1841) or the first season of its field operations (1843).

The functions of the Survey were set forth in the early legislation concerning it. Following the initiating motion in the 1841 session, an act dated March 17, 1845 (8 Vic. ch. 16) authorized the employment of competent persons to make an accurate and complete geological survey of the Province and to furnish a full and scientific description of its rocks, soils and minerals, accompanied by maps, diagrams and drawings along with a collection of specimens. By an act dated May 16, 1856 (19-20 Vic. ch. 13) publication of maps was authorized along with the installation of permanent bench marks to fix accurately latitudes and longitudes and relative levels of various points of reference. The provision of museum facilities was also envisioned.

For a prolonged period the Survey, although geological in essence, was the only government or other organization in Canada assembling information on Canada's natural resources. Later, as government departments expanded, other special branches were created to function in the various resource fields.[1] One of the principal obstacles to any effective geological survey of Canada in the mid-19th century was the lack of adequate topographical maps.[2] More than that, large areas of the country remained wholly unex-

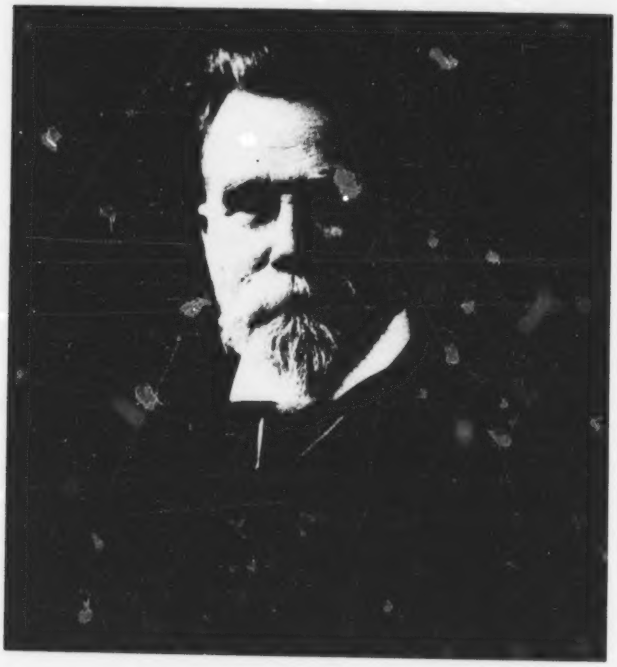
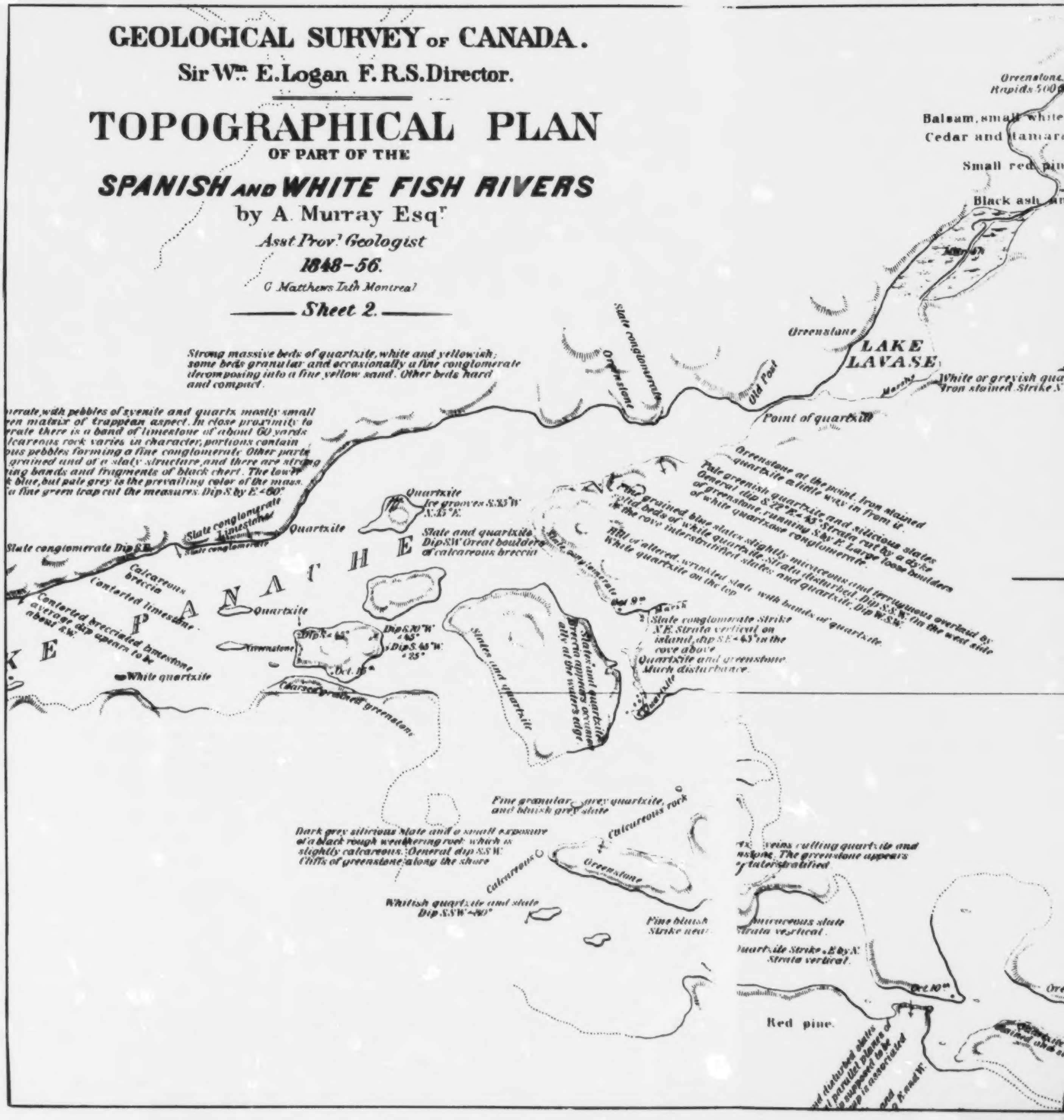
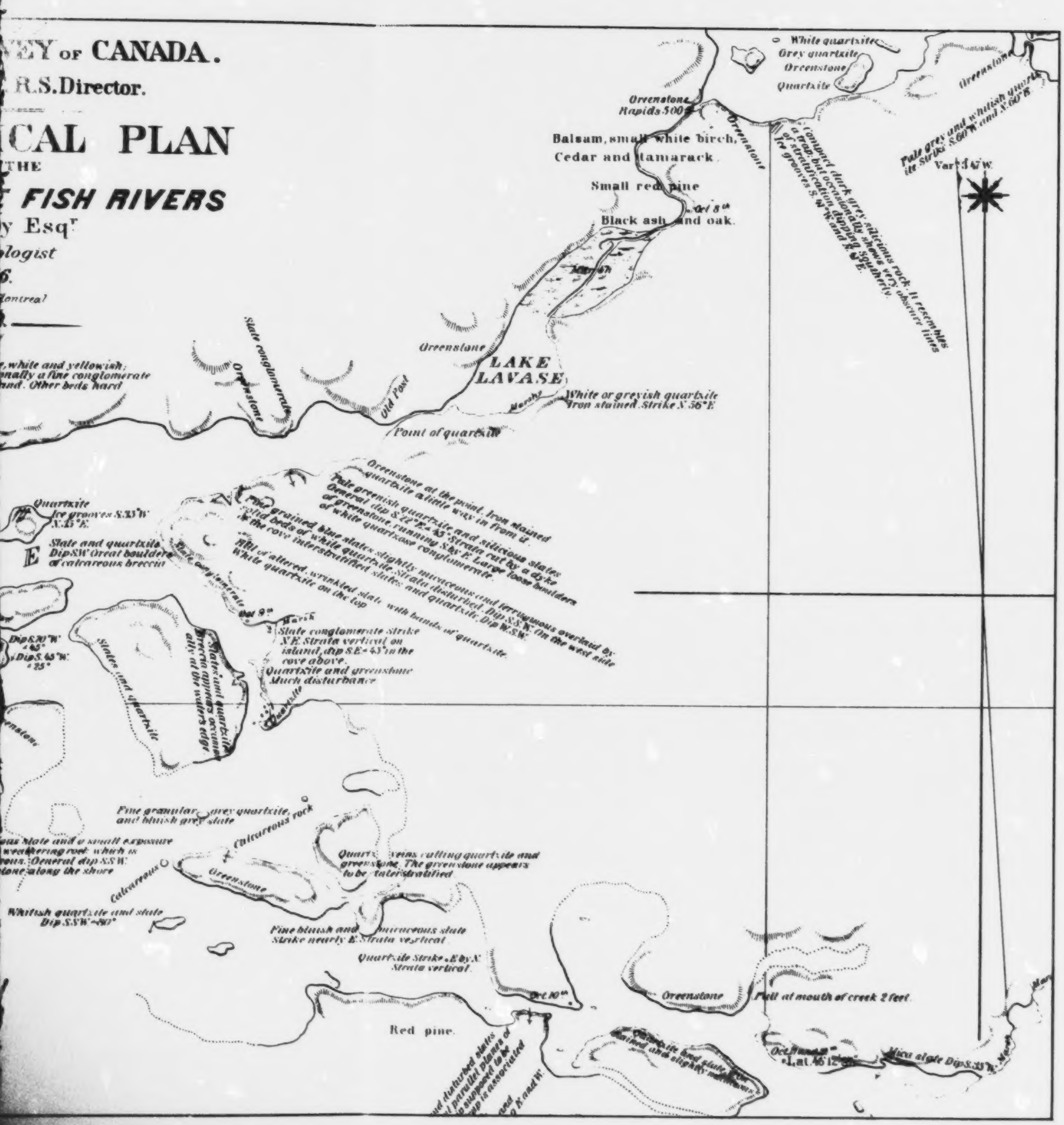


FIGURE 46
Dr. Robert Bell.


GEOLOGICAL SURVEY OF CANADA.
Sir Wm. E. Logan F.R.S. Director.
TOPOGRAPHICAL PLAN
OF PART OF THE
SPANISH AND WHITE FISH RIVERS
by A. Murray Esqr.
Asst Provl. Geologist
1848–56.
G. Matthews Lith. Montreal
Sheet 2.
LAKE LAVASE
Old Post
Point of quartzite
Slate conglomerate
Greenstone
Quartzite
Calcareous breccia
Contorted limestone
White quartzite
Balsam, small white
Cedar and tamarac
Small red pine
Black ash
Marsh
Red pine
Calcareous rock
Strong massive beds of quartzite, white and yellowish; some beds granular and occasionally a fine conglomerate decomposing into a fine yellow sand. Other beds hard and compact.
Dark grey siliceous slate and a small exposure of a black rough weathering rock which is slightly calcareous. General dip S.S.W. Cliffs of greenstone along the shore
Whitish quartzite and slate Dip S.S.W.
Fine granular grey quartzite, and bluish grey slate

MAP 37. Example of a combined topographical and geological survey carried out by the Geological Survey of Canada. Courtesy, G
of Canada.



VEY OF CANADA.
R.S.Director.
ICAL PLAN
THE
FISH RIVERS
y Esq.r
logist
6.
Montreal
White quartzite
Grey quartzite
Greenstone
Quartzite
Greenstone
Greenstone Rapids 500
Greenstone
Balsam, small white birch, Cedar and tamarack.
Small red pine
Oct 8th
Black ash and oak.
Marsh
Compact dark grey siliceous rock. It resembles a trap but occasionally shews very obscure lines of stratification dipping Southerly. Ice grooves S.40°W. and N.5°E.
Pale grey and whitish quartzite Strike S.60°W. and N.60°E.
Var. 3½°W.
Slate conglomerate
Greenstone
Old Post
Greenstone
LAKE LAVASE
White or greyish quartzite Iron stained. Strike N.56°E.
Marsh
Point of quartzite
, white and yellowish; onally a fine conglomerate hand. Other beds hard
Greenstone at the point. Iron stained quartzite a little way in from it.
Pale greenish quartzite and siliceous slates General dip S.22°E.<45° Strata cut by a dyke of greenstone running S.by E. Large loose boulders of white quartzose conglomerate.
Fine grained blue slates slightly micaceous and ferruginous overlaid by solid beds of white quartzite. Strata disturbed. Dip S.S.W. On the west side of the cove interstratified slates and quartzite. Dip W.S.W.
Hill of altered, wrinkled slate with bands of quartzite. White quartzite on the top.
Quartzite
Ice grooves S.35°W. N.15°E.
Slate and quartzite Dip SW Great boulders of calcareous breccia
E
Slate conglomerate
Oct 9th
Marsh
Slate conglomerate strike N.E. Strata vertical on island, dip S.E.<45° in the cove above.
Quartzite and greenstone Much disturbance
Dip S.70°W. <85°
Dip S.45°W. <25°
States and quartzite
Slates and quartzite Breccia appears occasionally at the waters edge
Quartzite
Greenstone
Fine granular grey quartzite, and bluish grey slate
Calcareous rock
ous slate and a small exposure weathering rock which is ous. General dip S.S.W. stone along the shore
Calcareous
Greenstone
Quartz veins cutting quartzite and greenstone. The greenstone appears to be interstratified
Whitish quartzite and slate Dip S.S.W.<80°
Fine bluish and micaceous slate Strike nearly E. Strata vertical
Quartzite Strike E.by N. Strata vertical.
Oct 10th
Red pine.
Greenstone
Fall at mouth of creek 2 feet.
Quartzite and slate iron stained and slightly micaceous
Oct 11th
Lat. 46°12'
Mica slate Dip S.35°W.
Marsh
nd disturbed slates parallel planes of supposed to be associated
and S and W.

…ed topographical and geological survey carried out by the Geological Survey of Canada. Courtesy, Geological Survey plored. In other countries, up to that time, the work of topographers had preceded that of geologists in the field. Possessed of a fairly correct representation of the land surface with properly related reference points, geological studies were made considerably less arduous. But in Canada the lack of such maps compelled the geologist to study its topography as an introduction to the portrayal of its geology.

These important concurrent tasks were performed with distinction by members of the Geological Survey for more than six decades and into the 20th century. In fact, in the Survey Report of 1902 its then director, Dr. Robert Bell, was able to claim that "the topographical service alone which has been rendered [by the Geological Survey] is worth more to the country than the whole cost of the Survey from the beginning". Such was the achievement of a small number of devoted men with very limited means at their disposal.

Before a government committee in 1854 Logan testified, when asked to state the principal difficulties faced by pioneer geologists, "Independently of those incident to travelling in canoes in shallow rivers and on foot through forests, are those arising from the want of a good topographical map of the country. *Accurate topography is the foundation of accurate geology.* Unless you know the geographical position of every rock exposure that comes before you, you cannot tell the general relations of the whole, and you cannot make the physical structure of a district intelligible to yourself and to others". (author's italics)

In a letter written as early as May 12, 1845, Logan stated, "Many parts of the country are so little known that Murray and I are in some places obliged to add topography to our geology. I wish I could let you see the map of our journey across the St. Lawrence to Bay Chaleur... If the economic facts of Canadian geology should turn out a negative quantity, the topographical facts may return some of the expense..." Dr. Bell was more dogmatic a half-century later.

A vivid picture of the outdoors life of the field geologist in those pioneer days is revealed in Logan's diary: "It is very dark and our fire heightens or brightens up its face. Our pork for tomorrow boils away right busily. The woods are becoming as silent as the grave, not a breath of wind is stirring. The faint strokes of the axe against a tree tell us that others are camping, probably within half a mile, and the monotonous gurgling of the river will perhaps tell them to slumber as well as us. John, an Indian helper, is on his knees and though his back is towards me I can see from the crosses he makes that he is saying his prayers. So it's time to prepare for bed".[3]

In a letter written in April, 1844, Logan describes to De la Beche some of his field experiences in the Gaspé region during the previous summer: "I worked like a slave all summer . . . living like a savage, inhabiting an open tent, sleeping on the beach in a blanket sack with my feet to the fire, seldom taking my clothes off, occasionally tormented by mosquitoes. I dialled [by means of an odometer or large wheel with a counting device attached to register distances traversed] the whole of the coast surveyed and counted my paces from morning to night for three months. My field-book is a curiosity".

On Logan's first official field party in the 1843 season he had as helpers a Mr. Stevens and John Basque, an Indian. During that same summer in the Gaspé region Logan records (July 18) that "Two men came after me a considerable distance today, evidently watching my movements very narrowly. They spoke to me at last and it seems they had considered me, from my various gambols about the rocks, out of my mind. Three clam-diggers did me the favour to inform me the same thing yesterday . . .".

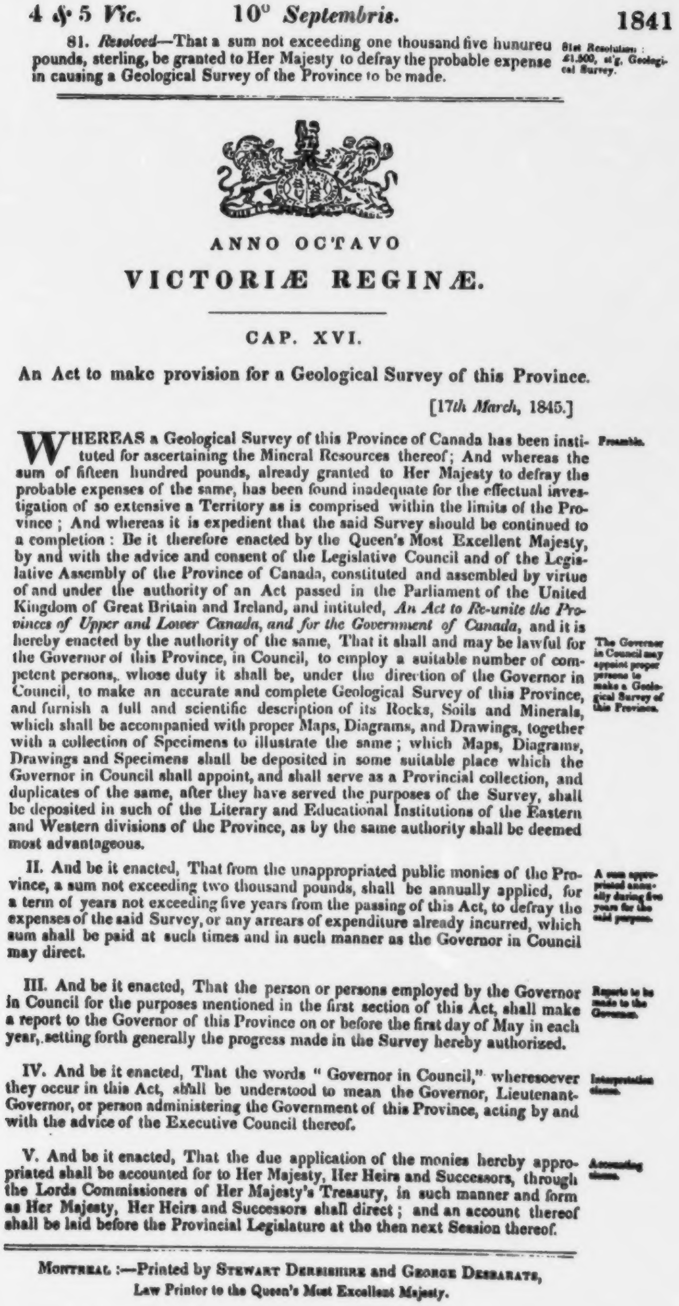
In 1844 Logan's expedition to the Gaspé was more elaborate. The party was transported in three canoes. Logan, Stevens and John Basque were in the first, De Rottermond, Frank and Louis in the second, Murray, Baptiste and Michel in the third. Logan's equipment was more impressive than ever. He carried a Rochon micrometer telescope and a prismatic compass. But physical trials were nevertheless severe. "I am tired", Logan once reported, "My shins are black and blue all over with thumps against stumps and fallen trees and my foot has been squeezed by getting into the fork of a root . . .". And again, "It was nine o'clock [p.m.] before we could get our supper, and I had tasted nothing from 7 a.m. We took no dinner on our journey yesterday [August 13] for want of water. All the men were thirsty, and none could eat without drinking first". Logan speaks often of a special delicacy in the field, the taste of well-cooked porcupine!

On his return to Montreal from the field in 1843 Logan was faced with the prospect of finding storage space for his rock specimens. His government grant was inadequate, he had no palaeontologist to classify fossils, no museum in which to display collections and, in fact, no room space at all in which to unpack his boxes.[4] At this awkward juncture James Logan came to his brother's aid and provided an upper room in his Gabriel Street (Montreal) warehouse in which for a period the Survey properties were deposited. In 1844 the Survey headquarters were moved to a rented house at 40 St. James Street. At about this time Logan firmly rejected an attractive offer to take charge of the geological survey of India. The winter of 1844-45 proved to be the low point in Logan's career. The £1,500 already voted had been exhausted, as well as £800 of his own money. Nobody could assure him of the continuance of the survey organization. Nevertheless Logan worked unceasingly on the drafting of a new Geological Survey bill and interviewing members of the House. So convinced were the members of the gross inadequacy of the money being voted for Survey purposes that not a single dissenting voice was raised when on March 17, 1845, an act was passed providing for an annual amount of £2,000 on a five-year basis. This proved to be the only subject to come before that session of the assembly on which there was unanimous agreement.

In 1846 the Survey's offices, museum and laboratory were moved to a larger building on Little St. James Street and remained there for six years. In 1852 even more commodious quarters were found in a former residence of Hon. Peter McGill on St. Gabriel Street. Here the Survey headquarters were maintained until the Logan regime came to an end. Financial problems continued to plague Logan. In 1850 and again in 1856 renewal of grants to the Survey work were arranged by statutes and a somewhat increased establishment sanctioned. But it was not until after an inquiry by a Select Committee of Parliament that a fairly substantial annual sum was voted for the Geological Survey. The provision was for $20,000 annually for five years and, in addition, a sum of $8,000 for publishing a map and report on the geology of Canada. By 1868 the yearly government grant had reached $30,000.

About 1854 a map on the scale of 25 miles to the inch had been hastily constructed from various published maps of Canada. As the over-all result had not been satisfactory the map was discarded. It was decided to compile topography from original surveys and to establish by telegraph the longitudes of several principal points in the country. By 1861 the new map was ready for engraving. But Sir William's massive geological map dated 1866 was not actually published until 1869, the year in which he resigned.

Over the years from 1843 to 1856 Logan's field work continued — up the Ottawa River, through Lake Timiskaming, on to Lake Superior as well as on the north shore of the St. Lawrence, in the Gaspé and in the Eastern Townships. All the while, in off seasons, Logan kept all his business accounts in his own hand, carried on extensive office correspondence in longhand, plotted all his own surveys, wrote his reports on field trips, edited the reports of his assistants, examined all fossils, minerals and rock specimens



4 & 5 *Vic.* 10° *Septembris.* 1841

81st Resolution: £1,500, st'g. Geological Survey.

81. *Resolved*—That a sum not exceeding one thousand five hunureu pounds, sterling, be granted to Her Majesty to defray the probable expense in causing a Geological Survey of the Province to be made.

ANNO OCTAVO

VICTORIÆ REGINÆ.

CAP. XVI.

An Act to make provision for a Geological Survey of this Province.

[17*th March*, 1845.]

Preamble.

WHEREAS a Geological Survey of this Province of Canada has been instituted for ascertaining the Mineral Resources thereof; And whereas the sum of fifteen hundred pounds, already granted to Her Majesty to defray the probable expenses of the same, has been found inadequate for the effectual investigation of so extensive a Territory as is comprised within the limits of the Province; And whereas it is expedient that the said Survey should be continued to a completion: Be it therefore enacted by the Queen's Most Excellent Majesty, by and with the advice and consent of the Legislative Council and of the Legislative Assembly of the Province of Canada, constituted and assembled by virtue of and under the authority of an Act passed in the Parliament of the United Kingdom of Great Britain and Ireland, and intituled, *An Act to Re-unite the Provinces of Upper and Lower Canada, and for the Government of Canada*, and it is hereby enacted by the authority of the same, That it shall and may be lawful for the Governor of this Province, in Council, to employ a suitable number of competent persons, whose duty it shall be, under the direction of the Governor in Council, to make an accurate and complete Geological Survey of this Province, and furnish a full and scientific description of its Rocks, Soils and Minerals, which shall be accompanied with proper Maps, Diagrams, and Drawings, together with a collection of Specimens to illustrate the same; which Maps, Diagrams, Drawings and Specimens shall be deposited in some suitable place which the Governor in Council shall appoint, and shall serve as a Provincial collection, and duplicates of the same, after they have served the purposes of the Survey, shall be deposited in such of the Literary and Educational Institutions of the Eastern and Western divisions of the Province, as by the same authority shall be deemed most advantageous.

The Governor in Council may appoint proper persons to make a Geological Survey of this Province.

II. And be it enacted, That from the unappropriated public monies of the Province, a sum not exceeding two thousand pounds, shall be annually applied, for a term of years not exceeding five years from the passing of this Act, to defray the expenses of the said Survey, or any arrears of expenditure already incurred, which sum shall be paid at such times and in such manner as the Governor in Council may direct.

A sum appropriated annually during five years for the said purpose.

III. And be it enacted, That the person or persons employed by the Governor in Council for the purposes mentioned in the first section of this Act, shall make a report to the Governor of this Province on or before the first day of May in each year, setting forth generally the progress made in the Survey hereby authorized.

Reports to be made to the Governor.

IV. And be it enacted, That the words "Governor in Council," wheresoever they occur in this Act, shall be understood to mean the Governor, Lieutenant-Governor, or person administering the Government of this Province, acting by and with the advice of the Executive Council thereof.

Interpretation clause.

V. And be it enacted, That the due application of the monies hereby appropriated shall be accounted for to Her Majesty, Her Heirs and Successors, through the Lords Commissioners of Her Majesty's Treasury, in such manner and form as Her Majesty, Her Heirs and Successors shall direct; and an account thereof shall be laid before the Provincial Legislature at the then next Session thereof.

Accounting clause.

MONTREAL:—Printed by STEWART DERBISHIRE and GEORGE DESBARATS,
Law Printer to the Queen's Most Excellent Majesty.

FIGURE 47. A composite of a Resolution of September 10, 1841, and an Act of March 17, 1845, of the Legislature of the Province of Canada, providing public monies in support of the Geological Survey of Canada in its formative years.

collected each year, kept himself up to date in the reading of geological reports of other countries and gave interviews to many visitors. In addition he prepared the Annual Report of the Geological Survey, also in his own handwriting, four manuscripts in all; one for the Governor General, one for the Legislative Council, one for the House of Assembly and one for the printer.

His field trips were not in the nature of holidays. In a letter to Murray he described his survey of the Ottawa and Mattawa rivers: "The bearings have been taken by a theodolite, and the whole of the map has been carefully protracted in the field on drawing paper as the work went on, on the scale of one mile to an inch. Every sight in levelling, every bearing, sometimes twenty at a station, every micrometer angle, every reduction of the distance to chains and links, and every line of the protraction has been worked out by my own hands. You may think, therefore, that I have been a little busy. I was up every morning at four or five o'clock to rouse my Indians (not one of whom would ever stir unless he had my special command), to be ready for an early breakfast and start. We seldom left our work until we could no longer see distinctly, and it was often one, two or three hours after midnight before my protractions were finished and I could creep into my blanket".

Logan's greatest work, in the writing field, was his volume *Geology of Canada, 1863.*[5] Although Prime Minister Sir John A. Macdonald was not sufficiently versed in science to appreciate the towering worth of this opus, both in Canada and internationally, its publication served to confirm Sir William's high place in the world of geology. His eminence had, in fact, been realized and recognized in 1856 when he received a knighthood at Windsor Castle and was showered with honors by many countries. From the Geological Society of Great Britain he was awarded the top honor in its power to bestow, the Wollaston Medal, annually given for "research concerning the mineral structure of the earth". It is not clear from available official records just precisely when Sir William became entitled to use the term "Director" in relation to the Survey. That title appears in some government reports as early as 1856 but he preferred to cling to the first Canadian description of his position, "Provincial Geologist" even after his colleagues made rather insistent use of the word "Director".

Very important parts of the *Geology of Canada, 1863* were written by T. Sperry Hunt, especially on mineralogy, mineral waters, petrography and economic geology. In his 25 years with the Survey Dr. Hunt made an immense contribution. He is credited with being the first to point out the relation of petroleum deposits to anticlinal folds. Recognition of this geological fact led in the long future to immeasurable economic results. He wrote reports on *Gold Mines of Canada* (1863); *On Petroleum in the Gaspé* (1865) and *On the Gold Regions of Lower Canada* (1866).

An Atlas of geological maps, published in 1865, accompanied the 1865 opus. It contains Logan's handsome map showing the distribution of Laurentian rocks (Grenville region). The maps were engraved on steel or copper and printed in oil colors by chromolithography.

Logan's relations with McGill University were, in effect, the story of his friendship with the man who became its Principal in 1855, namely, Dr. (Sir) John William Dawson. After lecturing at Dalhousie University Dawson had been appointed Superintendent of Education for Nova Scotia in 1850. Two years previously a son, George Mercer Dawson, had been born, destined to become a Director of the Geological Survey of Canada. The father's interest in geological matters never faltered and his most important writing was done in his book *Acadian Geology*. He had his heart set, however, on a professorship of geology and zoology at Edinburgh University. On the day in 1855 that he planned to sail to Scotland to seek this post he received word that the vacancy had been filled. On that same day he received a letter from the board of governors of McGill inviting him to become principal of that institution. He had been suggested to the governors by the Governor General, Sir Edmund W. Head. Dawson continued in the principalship for 44 years, and in the post donated various objects of scientific value to the Survey. Logan, for his part, demonstrated his admiration for an old friend by instituting the Logan Gold Medal and by endowing a Chair of Geology at McGill.

Logan, though of small frame, was physically and mentally tireless in his resolve to make Canada's mineral resources more widely known and to have them more intensively developed. Any genuine effort to put Canadian mineral resources to good use had his constant encouragement. But for the fraudulent who tried to promote such spurious projects as 'salted mines' he had only contempt. On one occasion, according to Professor H. Y. Hind, Logan was urged to give his opinion on some quartz samples in the presence of men intent on purchasing the properties that had ostensibly produced this ore. His opinion was asked on whether the glittering metal, visible in small cavities in the quartz, was really gold. "No doubt about it", Logan said, examining it closely with a pocket magnifier, "No doubt of it; and with this glass you can see the marks of the punch perfectly!"

Logan remained a bachelor with the same singleness of purpose as he displayed in advancing the progress of Canada's geological survey. Personal discomforts he endured lightly and replied to any efforts to find him a bride that he was more interested in rocks than in the rocks of any cradle. He possessed a fine sense of humor and a hearty, infectious laugh. He delighted to tell such stories as that of his attempt in the field one day to get an idea of the width of a stream by tossing stones across it. Addressing his Indian helper Logan said, "John, bring me some stones to throw across this river". John Basque, proud of his ability to employ geological terms he had overheard replied, "Yes, sir, conglomerate, limestone or slate, Mr. Logan?".

But Logan's jollity failed him on one occasion. He was accustomed to plot his maps on foolscap sheets. At a wayside inn the housemaid took a fancy to the eminent geologist without realizing just who he was. To declare her undying love for him she wrote loving verses all across his precious map sheets. She was astonished at his visible annoyance. It is surmised that Logan failed to file these particular map sheets in departmental records.[6]

Over the critically important formative years of the Survey, Logan was probably its most active worker as well as its greatest individual financial benefactor. He was a guiding spirit and dedicated leader who had an unflagging passion for research and was intensely interested in exhibits of mineral samples as a means of drawing favorable attention to Canada and its natural resources. He was not parochial in any sense. His was not only a zeal for Canada but an outlook as wide as the world itself.

During the quarter-century Logan presided over the fortunes of the Geological Survey of Canada he built up its staff and obtained accommodation for them in Montreal. He himself carried out extensive geological investigations and directed the work of others in the field. He did much valuable mapping and sketching as well as collecting rock and fossil specimens. He arranged and supervised Canadian geological exhibits abroad. Although he retired in 1869 at the age of 71 he continued to be active in his beloved profession. Something of his profound faith in his country shines through a letter he wrote: "Just look at Arrowsmith's little map of British North America, dedicated to the Hudson's Bay Company, published in 1842. If you have not got a copy, send for one; the expense won't kill you and there ought to be one in your Record Office. You will see that Canada comprises but a small part of it... It will be a great country hereafter. But who knows anything of its geology?"

Showered with honors in his lifetime Logan was not slow to appreciate worth in others. The acknowledgments in his preface to *Geology of Canada, 1863* are like a roll call of surveyors representative of all categories of the profession. There are tributes to Joseph Bouchette, Surveyor General of Lower Canada and to his son Joseph, Deputy Surveyor General, for their map work; to Sandford Fleming of Toronto for information supplied; to Dr. (Sir) J. W. Dawson for his donations of geological specimens and to Admiral Bayfield for his list of latitudes and longitudes of the coasts of Labrador, Nova Scotia, New Brunswick, Cape Breton, Prince Edward Island, Anticosti and the Magdalens.

By the time of Logan's retirement, appreciation of the value of geological surveys to the progress of the nation was immeasurably more widespread in Canada than was the case when he began his work 27 years earlier. His professional reputation outside of Canada was exceptionally high. Logan had a keen appreciation of the value of geological science and its application to Canadian mineral resources. He understood thoroughly the interdependence of scientific and applied geology and his demonstrations of this comprehension, especially in research on formations of the Canadian Shield generated a sounder popular realization at home and abroad of the extent and potential worth of Canada's natural resources.

On his death in 1875 the Natural History Society of Montreal heard a moving tribute to his work and memory:

"No man has done so much to bring Canada before the notice of the outside world and no man is more deserving of being held in remembrance by the people. Just as statesmen and generals have risen up at the moment of greatest need to frame laws or fight battles, so Sir William appeared to reveal to us the hidden treasures of nature just at a time when Canada needed to know her wealth in order to appreciate her greatness".

Logan's name lives on in the title of Canada's highest mountain peak; in mountains in the Yukon and of a great glacier in that same territory; in an island, mountain and township in the province of Quebec; in Logan Hall of the Geological Survey building in Ottawa and in the Logan Club with its membership open to all interested in geology; in the Logan Professorship at McGill University and in the Logan Medal given on an annual basis by the Geological Association of Canada for "meritorious work in geological science".

In addition to other plaques, such as the one at Percé in the Gaspé, there is one outside the Victoria Memorial Museum Building in Ottawa fastened to a large boulder of Ottawa gneiss, representative of a formation Logan named. On the bronze borne by the boulder is the simple yet eloquent inscription:

SIR WILLIAM LOGAN
K.B. LL.D. F.R.S.
1798-1875
THE FATHER OF CANADIAN GEOLOGY
FOUNDER AND FIRST DIRECTOR OF THE GEOLOGICAL
SURVEY OF CANADA
1842-1869
ERECTED BY THE TWELFTH INTERNATIONAL GEOLOGICAL CONGRESS
CANADA
MCMXIII

ACKNOWLEDGMENTS

I acknowledge with deep gratitude the assistance I have received from many sources in the organizing of factual and illustrative material for these volumes. Within the Department of Mines and Technical Surveys, in addition to appreciation expressed elsewhere in this volume to ministers and deputy ministers I wish to thank Assistant Deputy Ministers J.-P. Drolet and Dr. J. M. Harrison. I am most grateful to S. G. Gamble, Director, Surveys and Mapping Branch, for his unwavering encouragement and support. Dr. W. Kaye Lamb, Dominion Archivist and his staff have given indispensable help.

My special thanks are extended to those with whom I have been most closely associated in this history project: to Maurice Caron of Quebec City upon whom I have relied heavily for contributions in the form of translations and research work pertaining to early records of Quebec surveys and mapping; to T. E. Layng, Chief, Map Division, Public Archives of Canada; and to E. D. Baldock, Chief, Map Compilation and Reproduction Division, Department of Mines and Technical Surveys, and his competent staff for the selection and reproduction of maps; to Douglas Shenstone of Editorial and Information Division of the Department in his capacity as editor, and to Miss Florence Stephens as typist.

I am greatly indebted also to a number of archivists across Canada, all of whom placed their staffs, records and office facilities at my disposal.

For guidance in the field of military surveys and mapping I wish to gratefully acknowledge the assistance of officers of the Army Survey Establishment, R.C.E., Ottawa.

I have received valuable and willing assistance from Chief librarians and their staffs in the following institutions: Public Archives of Canada, Library of Parliament, Geological Survey of Canada Library, Geographical Branch and Surveys and Mapping Branch libraries of the Department of Mines and Technical Surveys; libraries of the Universities of New Brunswick and British Columbia; the Tri-Service Library, Department of National Defence, Ottawa; Toronto Public Library; St. John's (Newfoundland) and Charlottetown Public Libraries; Library of the Royal Military College, Kingston; Headquarters Libraries of the Canadian Pacific Railway and of the Canadian National Railways in Montreal. I derived much information as well from the resources of the legislative libraries of Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia as well as of the Redpath Library, McGill University.

I wish to extend special thanks also to officers and staff members of the Department of Mines and Technical Surveys, Ottawa, and the government survey offices in each of the ten provinces.

In the vitally important task of translating the English text into *la langue de Molière* for the French volumes of "Men and Meridians" I am under heavy obligation to the following members of the Translation Bureau, Department of the Secretary of State, Ottawa and Montreal offices: Louis Lebel, Chief, Translation office, Department of Mines and Technical Surveys; P. Guillemin, Montreal office, and C. E. Lamb.

In addition to these various forms of assistance I had the advantage of interview in person with the following survey officials and surveyors, active and retired, many of whom are Provincial or Dominion Land Surveyors or both:

Arthur Ames
G. S. Andrews
Col. W. S. Archibald
Roland J. Auger
E. W. Bassett
Dr. C. S. Beals
H. E. Beresford
A. I. Bereskin
Spencer Ball (Professor)
George T. Bates
C. Bickerton
Will R. Bird

W. V. Blackie
T. J. Blachut
Miss Phyllis Blakeley
Guy Blanchet
Joseph Blanchet
D. H. Bocking
Major C. C. J. Bond
Mrs. H. L. Boone
Fernand Boutin
Rev. M. W. Burke-Gaffney (Professor)
James Canning
W. F. Canning

A. J. Campbell
Dean S. J. Carewe
John Carroll
Major J. L. Charles
Ken G. Chipman
A. F. Chisholm (Professor)
Ralph W. Clark
Robert G. Code
Dr. Georges Côté
Walter C. Cunningham
Marc Dancose
W. Mel Dennis
Mlle. Jeanne Desilets
(Dean) Fred Dineen
Hartley G. Dwyer (Washington, D.C.)
A. J. Elder
John Elliott
H. McL. Elliott
J. M. C. Facey (Professor)
Dr. A. L. Farley (Professor)
Earle J. Fennell (Washington, D.C.)
Dr. C. Bruce Fergusson
R. H. Field
Fred Fleming
Ian Fox
A. M. Fraser
Eric S. Fry
Herman R. Friis (Washington, D.C.)
E. Gauer
A. C. Gerlach (Washington, D.C.)
Mrs. M. Glenday[1]
Lieut.-Col. L. F. Grant
Norman G. Gray
F. C. Green
L. E. Harris
Dr. D. C. Harvey
Mrs. P. E. Heather[1]
C. T. Helstrom
George H. Herriot
Dr. John H. Hodgson
D. C. Holmberg
Dr. L. E. Howlett
Wilfred Humphreys
Willard E. Ireland
Dr. J. D. Ives
Louis Joncas (Professor)
S. H. de Jong (Professor)
Admiral H. Arnold Karo (Washington, D.C.)
Dr. Max O. Klotz
J. O. Kilmartin (Washington, D.C.)
Dr. Paul E. Lachance
F. A. Lamb
A. Fred Lambert, D.T.S.
C. D. Landell
Major H. H. Lawson
T. A. Lendrum[2]
G. H. Leaver
Carl W. Lester
J. E. Lilly, D.T.S.
Mrs. Millicent Lord[3]
Col. C. C. Lindsay
R. G. Madill
S. E. March
J. R. March
Francis J. Marschner (Washington, D.C.)
O. W. Martyn
Major J. S. Mathews
Dr. A. E. MacDonald
W. G. MacElhanney
B. R. MacKay
Dr. Frank MacKinnon
David MacMillan
Major Edgar MacNutt
W. S. MacNutt (Professor)
Gilbert B. McColl, D.T.S.
Mrs. K. F. McCusker
K. McGrath
R. B. McKay
G. M. McKay
General A. G. L. McNaughton
William McPhillips
D. F. McQuat
O. M. Meehan
Mrs. L. Morrison[1]
C. H. "Marsh" Ney
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Commander Harley D. Nygren (Washington, D.C.)
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Miss Mary Ogilvie[4]
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Harry Parry, D.T.S.
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E. Kent Phillips
John G. Pierce
Emilien Pouliot
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A. H. Ralfs
J. A. Reardon
Charles E. Remington (Washington, D.C.)
Lieut.-Col. Willis F. Roberts

Dr. Walter Ristow (Washington, D.C.)
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J. Earl R. Ross, D.T.S.
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R. P. Shaw
F. M. Shorthall
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C. T. Smith
Nelson W. Smith (Washington, D.C.)
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Dr. G. M. Storey (Professor)
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Col. M. C. Sutherland-Brown
Arthur F. C. Swannell
Frank Swannell
C. Harry Taggart
R. Thistlethwaite
William Taylor
J. C. Traynor
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A. C. Tuttle
Ian W. Tweddell (Professor)
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Peter Wilson (Professor)
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Royal Military College Review, Kingston, Canada, and Log of H.M.S. Stone Frigate.

Anon. The Capture of Vimy Ridge. Canadian Army J. v. 5, no. 7.

Reference Notes

Chapter 1. EARLY MAN DRAWS HIS PLANS AND BOUNDARIES

[1] This is Assyrian in origin. It was found at Nuzi near Kirkuk and dates from the dynasty of Sargon of Akkad.

[2] An Eskimo aboard H.M.S. *Assistance* during the winter of 1850-51 drew a remarkable map, based upon memory and first-hand observations of the west coast of Greenland.

[3] The account of Herodotus of an interview between Aristagorus of Miletus and the Spartans relates how Aristagorus produced a tablet on which was inscribed "the circumference of the whole earth, the whole sea and all the rivers."

[4] A. E. Nordenskiold. *Periplus*, p. 5.

[5] This was the estimate of Poseidonius (130 B.C. - 51 B.C.) who used a star as the basis of his calculations rather than the sun.

Chapter 2. THE ROMANS AND RECTANGULAR LAND SURVEYS

[1] Del Catasto Romano e di Alcuni strumenti antichi di Geodesia. Padua, 1887.

[2] Fabricius. *Limitatio* in: Pauly-Wissowa, editor, Realencyclopädie der classischen Alterumswissenschaft, v. 13, p. 676.

[3] Fabricius, p. 690.

Chapter 3. MAPPING IN THE MIDDLE AGES

[1] Now in the Bibliothèque Nationale, Paris. Attributed to Cresques, a Jew.

[2] The earliest known description of a cross-staff, by Levi Gerson, was dedicated to Pope Clement VI in 1342. Gerson called the instrument "Jacob's Staff". The cross-staff was likely introduced to mariners by Martin Behaim, a celebrated navigator and mapper.

Chapter 4. THE GOLDEN AGE OF DISCOVERY

[1] The Portuguese historian Gomes de Azurara makes reference to the superstitions prevailing in Europe in the 15th century regarding the South Atlantic regions adjoining Africa in his "The Chronicle of the Discovery and Conquest of Guinea." This is available in English from *The Hakluyt Society*; 1896-99, ser. 1, vols. 95, 100.

[2] *Encyclopaedia Britannica*; 1962 ed., v. 5, 836.

[3] The Astrolabe: Its Uses and Derivatives; *Scot. Geog. Mag.*; 1927. v. 43, 135. See page 139.

[4] E. G. Racienstein. "Martin Behaim, His Life and His Globe." London, 1908, pp. 12-15.

[5] Fra Mauro, a monk of Murano near Venice, appears to have had an outstanding reputation as a cartographer in the 15th century. In 1457 he was commissioned by the King of Portugal to make a world map and for this purpose was shown charts depicting the latest Portuguese discoveries.

Chapter 5. THE RENAISSANCE IN THE ARTS OF MAPPING AND SURVEYING

[1] J. O. Halliwell, "Rara Mathematica". London, 1839.

[2] A modern theodolite is a precision surveying instrument similar to the present-day transit, but is larger and heavier in construction, with a more finely graduated circle and more sensitive levels. Readings are made by means of micrometer microscopes to the nearest second and by repetition and direction procedures to tenths. Two closely spaced vertical cross hairs are employed. Theodolites are principally used in geodetic triangulation where precise angles are needed and sightings made on distant light signals are required at night.

[3] In a mss. map of Ireland by the Dean of Lichfield in the 1560s the Dean is shown with a bundle of chain at his feet. A photograph of this map is in the British Museum Map Room, London. For further details of a surveyor's outfit in the 16th century see *Scot. Geog. Mag.* v. 45, 1929, p. 210.

[4] *Encyclopaedia Britannica*; 11th edition, p. 558, item "Telescope".

[5] Circumferentor: an instrument used by surveyors for taking angles. It consists of a graduated brass circle, marked in quadrants, a set of sights revolving around the same centre as the magnetic needle, suspended above the centre of the circle. The sights being directed to an object, the angle which it makes with the magnetic meridian is noted. The sights are then directed to a second object, and the angle it makes with the same meridian observed in like manner. The difference or sum, as the case may be, of the observed angles gives the angle between the two objects. This instrument was also known as a land-compass (Charles E. Smart, "The Makers of Surveying Instruments in America." Troy, N.Y., 1962, p. 15.)

[6] T. E. Layng. Introduction to "Sixteenth-Century Maps Relating to Canada". Public Archives of Canada, 1956, p. XI.

[7] Melvin H. Jackson. "The Labrador Landfall of John Cabot, 1497", in *Can. Hist. Review*. v. 44, no. 2, 134.

[8] This manuscript chart of the world, 38 inches by 60 inches, is in the Museo Naval, Madrid.

[9] Proceedings (1888) *Roy. Geog. Soc. Lond.*, v. 10, 256; also: *Encyclopaedia Britannica*; 11th ed., p. 828.

Chapter 6. CHAMPLAIN—THE BROUAGE VOYAGEUR

[1] Father Gabriel Sagard Theodat (H. Emile Chevalier). "L'Histoire du Canada". Paris, Librairie Tross. 1866, p. 168.

[2] J. Edmond Roy. "La Cartographie et l'Arpentage sous le régime français", in *Bull. Recherches Historiques*; v. 1, part 1, 17, Lévis, Que., 1895.

[3] Thwaites. The Jesuit Relations and allied documents; v. 2, note 80.

[4] Champlain's Voyages (1632); part 2, pp. 144, 183.

[5] "Seigniory Grants in New France, 1623-1758". Laval University, Quebec.

[6] W. B. Munro. "Documents Relating to the Seigniorial Tenure in Canada", 1908.

[7] Sir James McPherson Le Moine. "Maple Leaves". p. 107.

[8] "Histoire de la Colonie Française dans le Canada". v. 3, p. 384.

[9] W. R. Kermack. "The Historical Geography of Early Canada". *Scot. Geog. Mag.* v. 43, p. 98, 1927.

[10] "Planning Study of Kingston, Ontario, 1960"; p. 1.

[11] James A. Roy. "Kingston—The King's Town". p. 2.

[12] *Encyclopaedia Britannica*; 11th ed., v. 27, p. 1031. "Construction, Usage, et Propriétés du Quadrant Nouveau de Mathématiques".

[13] N. E. Dionne. "Makers of Canada" series; v. 1. pp. 195, 224.

[14] "Oeuvres de Champlain", 1-4 (1870); tome 3, p. 274.

[15] H. P. Biggar, editor. "Samuel de Champlain Works"; 8 vols. and a portfolio of plates and maps. The Champlain Society, Toronto. 1932.

[16] Paul Lachance. "L'Arpenteur-Géomètre au Canada Français". Quebec, 1962.

Chapter 7. NURSERY FOR NAVIGATORS

[1] *Encyclopaedia Britannica*; 11th ed., v. 24, 183.

[2] Thwaites. Jesuit Relations. v. 9, 136.

[3] Thwaites. Jesuit Relations. v. 9, 48.

[4] H. Harrisse. "Notes pour servir à l'Histoire, à la Bibliographie et à la Cartographie de la Nouvelle-France et des Pays Adjacents, 1545-1700". Paris, 1872, no. 190, 191.

[5] This Bourdon map is signed, dated and in the keeping of the Depôt des Cartes de la Bibliothèque Nationale, Paris.

[6] Arthur Massé. "L'Arpentage sous le régime français". Quebec, 1945.

[7] Thwaites. Jesuit Relations. v. 28, 42; "Une Lunette de Galilée ou il y avait une Boussole".

[8] Thwaites. Jesuit Relations. v. 31, 108.

[9] Thwaites. Jesuit Relations. v. 37, 118.
[10] Thwaites. Jesuit Relations. v. 44, 188.
[11] H. Harrisse. "Notes pour servir . . .". no. 192, p. 192.
[12] Benjamin Sulte. "Histoire des Canadiens-Français". Montreal, 1882.
[13] P. G. Roy. *Bull. Recherches Historiques*. v. 1, 4. Lévis, Qué., 1895.
[14] *Encyclopaedia Britannica*; 11th ed., v. 6, 658.
[15] Donald G. Creighton. "Dominion of the North". p. 57.
[16] Rev. M. W. Burke-Gaffney. "Canada's First Engineer". *Can. Cath. Hist. Assoc.*, 1957, Rept. 100.
[17] Thwaites. Jesuit Relations. v. 60, 140.
[18] Archives des Colonies; Paris, C11A, 7:94v. de Denonville to Seignelay.
[19] ——————————, 7:104.
[20] Parkman's Works, app. 1, v. 2, p. 225. La Salle and the Discovery of the Great West.
[21] Archives des Colonies; Paris, C11A 11, 193. de Denonville to Seignelay.

Chapter 8. DIRECTION FINDERS OF NEW FRANCE

[1] This itemized account is at the archives of the Quebec Seminary, Laval University. See also E. Gagnon. "Louis Jolliet", Quebec, 1902, p. 80.
[2] Thwaites. Jesuit Relations. v. 54, 188.
[3] Archives des Colonies; Paris. 11E 13, 135-6.
[4] Jolliet's journal of the 1694 Labrador expedition is contained in its entirety in "Rapport de l'Archiviste de la Province de Québec 1943-44" with reproductions of 16 original sketches.
[5] The name "Zoar" is of Biblical origin, see Genesis ch.19, v. 22 where it is described as a "city of refuge". Labrador's "Zoar" had been a mission post but in 1946 was apparently abandoned as such. Zoar marked the northernmost point reached by Jolliet on his 1694 expedition.
[6] Archives des Colonies, Paris. AC—B19, 262. See also E. Gagnon. "Louis Jolliet". p. 330.
[7] Public Archives of Canada. General Correspondence, v. 7. Letter of de Denonville to Seignelay.
[8] "Il profita d'une eclipse de lune pour fixer la longitude de Québec". *Bull. Recherches Historiques*. v. 1, 36, and v. 32, 139.
[9] Archives des Dêpots des Cartes du Ministère des Affaires Etrangères. Paris. No. 8658. Carte Marine de l'embouchure de la Rivière de St. Laurens, levée de cap en cap jusqu'a Québec vérifiée par plusieurs observations.
[10] Bibliothèque Nationale Hydrographique Archives. Chart of the St. Lawrence (1686): Portefeuille 126, Division 1, no. 4. Mss. chart covering the coast of Labrador (1704): Portefeuille 126, Division 3, no. 8. Copy in Public Archives of Canada, Map Division, Ottawa.
[11] Joint letter dated October 5, 1701, of Governor Callières and Intendant Champigny to the Minister of Marine, Paris. Public Archives of Canada: Series C11A, v. 19, 1-42.
[12] Gosselin. "*L'Instruction*", p. 340: also J.-Edmond Roy. "La Cartographie et l'Arpentage sous le régime français", in *Bull. Recherches Historiques*; v. 1, 52, Lévis, Qué. (1895).
[13] *Trans. Roy. Soc. Can.* 2nd series (1895), Sect. I, v. 1, 25-61.
[14] Thwaites. The Jesuit Relations. v. 69.
[15] Mss. at Collège Sainte-Marie, Montreal, A.C.S.M., 596.

Chapter 9. SEIGNIORIES AND SURVEYS

[1] Edits et Ordonnances; v. 3, 7. Also W. B. Munro. "Documents Relating to the Seigniorial Tenure in Canada". p. 1.
[2] "Titres des Seigneuries"; p. 53, 373. Also "Seigniory Grants in New France 1623-1758"; p. 1, Laval Univ. Library, Quebec.
[3] *Bull. Recherches Historiques*. v. 42, 336. Lévis, Qué., 1936.
[4] Conseil Souverain de la Nouvelle-France; v. 42, 336 (1936) v. 1, 263.
[5] P.-G. Roy. *Bull. Recherches Historiques*. v. 23, 303.
[6] General correspondence. Archives of the Colonies; Paris. v. 33, 278.

[7] (Translation) "Map of the Three Rivers government which includes, when going down the St. Lawrence, the region from Lake St. Peter's exit to Ste. Anne. Surveyed in 1709 by orders of the Count of Pontchartrain, Commander of the King's Orders, Minister and Secretary of State, by Sr. Catalogne, Lieutenant of troops, and drawn by Jean Baptiste Decouagne."

[8] W. B. Munro. "Documents Relating to the Seigniorial Tenure in Canada". pp. 72-3 and 147.

[9] Introduction, p. 21.

[10] Conclusion of Introduction, p. 116.

Chapter 10. THE AGE OF THE EARLY ENGINEERS: REDUCTION OF LOUISBOURG

[1] Arthur Massé. "L'Arpentage sous le régime français". *Publ. Soc. Géod. Québec*, p. 4, 1945.

[2] Public Archives of Canada. Letter of May 8, 1686. C11A General Correspondence, v. 8, 15.

[3] Letter of September 10, 1686. C11A General Correspondence, v. 8, 225.

[4] Letter of June 8, 1687. C11A General Correspondence, v. 9, 47.

(Note: General Correspondence volumes in Public Archives of Canada carry alternate identification numbers, e.g. vol. 8 = vol. 9; vol. 9 = vol. 11.)

[5] J.S. McLennan. "Louisbourg: From Its Foundation to Its Fall." p. 288.

De Catalogne died in 1729 leaving a widow, four daughters and a son all in dire poverty. It is difficult to assess accurately the importance or extent of de Catalogne's contribution to the construction of Louisbourg defences. He occupied the post of assistant engineer (sous ingénieur) in relation to both Ile Royale and Ile St. Jean in 1720 and 1721. He was promoted to Captain in 1723. But Verrier's right-hand man and assistant at Louisbourg was Pierre Boucher. At least four of Boucher's signed maps of Louisbourg and vicinity are still extant.

[6] See text on Mitchell map, 3rd edition, reprint; 32 linen leaves. Public Archives of Canada, Map Division, Ottawa.

[7] See: "Voyage fait par ordre du roi en 1750 et 1751 dans l'Amérique Septentrionale pour rectifier les cartes des côtes de l'Acadie, de l'Isle Royale et de l'Isle de Terre-neuve, et pour en fixer les principaux points par des observations astronomiques", by M. de Chabert de l'Imprimerie Royale. Paris. 1753.

[8] A List of General and Field Officers. J. Millan, London. 1758-59 editions. Dept. of National Defence Tri-Service Library, Ottawa.

[9] See letter dated Quebec, January 11, 1792, in Simcoe Papers, Provincial Archives of Ontario, Toronto. (Major Samuel Holland to Governor J. G. Simcoe.)

Chapter 11. NOTABLE PIONEER SURVEYORS OF BRITISH NORTH AMERICA

[1] Quebec Instruction Book; no. 5, p. 9. *See also* 1886 Proceedings; *Assoc. Ont. Land Surv.*, p. 29.

[2] ———————————— no. 5, p. 11.

[3] ———————————— no. 5, p. 1.

[4] Public Archives of Canada; 1905, v. 1. Part 2, pp. 12-22.

[5] Land Grants in P.E.I.; v. 1, Part 2, Order in Council (Imp.) pp. 12-22, 1767.

[6] Public Archives of Nova Scotia. Publ. no. 2, p. 32.

[7] Provincial Archives of Ontario. Surveyors' Letter Book, 1784-1791. CPL Shelf 14, no. 8, p. 17.

[8] Description of Northern District: "All His Majesty's territories in North America which lie to the north of the Potomac River and of a line drawn due west from the head of the main branch of that river as far as His Majesty's dominions extend". See Royal Instructions, Feb. 10, 1764.

[9] Public Archives of Canada; ser. 3, MG 23, pp. 1-230.

[10] He ate poisonous fish in New Caledonia. See: Cook's Journals, Sept. 8, 1774. (Second Voyage).

[11] See: Summary of Selected Mss., Archives of Hydrographic Department, Admiralty, London, 1950.

[12] *Encyclopaedia Britannica*; 1962 ed. v. 6, p. 371.

[13] The Cambridge History of the British Empire, v. 6, ch. 5, p. 144.

Chapter 12. MARITIME PROVINCES SURVEYS AND THE LOYALIST INFLUX

[1] Surveyor General Holland to Lord Dorchester, letter dated January 31st, 1791, in accordance with terms of an Order-in-Council dated January 4th, 1791, requesting a report (list) of all surveying instruments in the office of the Surveyor General or in the hands of Deputy Surveyors. *Ont. Hist. Soc. Papers*, v. 21, 56.

[2] The following titles are listed in *Ont. Hist. Soc. Papers*, v. 21, 38:

Observations made on Islands of St. John and Cape Breton, 1769.
Astronomical Observations, 1769.
Eclipses of Jupiter's Satellites observed near Quebec, 1774.
Astronomical Observations, 1774.

[3] Arrêt du Conseil d'État du Roi concernant les concessions faites des terres de la Province d'Acadie dans la Nouvelle France. Archives de la Marine, série A1, liasse 39. Also: Winthrop Bell. "The 'Foreign Protestants' and the Settlement of Nova Scotia". Univ. Toronto Press, 1961, pp. 64-83.

[4] S. Bruce Fergusson. *The Dalhousie Review*, Spring, 1955, v. 35, no. 1, 16. Also: A. MacMechan, editor: Philipps to Board of Trade, August 16, 1721. Nova Scotia Archives II. A Calendar of Two Letter-Books and one Commission-Book in the possession of the Government of Nova Scotia, 1713-41. Halifax, 1900, 70.

[5] A. MacMechan, editor. Original Minutes of His Majesty's Council at Annapolis, 1720-39. Public Archives of Canada, p. 195.

[6] A Calendar of Two Letter-Books and One Commission-Book, p. 124.

[7] Beamish Murdoch. "A History of Nova Scotia". v. 2, 128.

[8] Public Archives of Nova Scotia; Commission Book, v. 1, 490.

[9] Beamish Murdoch. "A History of Nova Scotia". v. 1, 490.

[10] G. G. Campbell. "The History of Nova Scotia". The Ryerson Press, 1948. Ch. 16, 144; ch. 17, 152.

[11] Public Archives of Nova Scotia, v. 174, pp. 174, 290.

[12] *Bulletin* of the New York Public Library (Feb., March, May and Sept. 1931), v. 35. "Narrative of American Voyages and Travels of Captain William Owen, R.N. and the Settlement of the Island of Campobello in the Bay of Fundy, 1776-71".

[13] Dictionary of National Biography, v. 60. Macmillan, 1899.

[14] Collections of the New Brunswick Historical Society, v. 3, no. 7, 77, 112, no. 8, 204-277: "Benjamin Marston of Marblehead, Loyalist, His Trials and Tribulations During the American Revolution".

[15] Anthony Lockwood. "A Brief Description of Nova Scotia". G. Hayden, London, 1818, pp. 72-74.

[16] Provincial Archives of Nova Scotia. Letters from Surveyor General Morris to his Deputy Surveyors relating to Loyalist Land Grants, 1785-1800; v. 396, p. 97, Halifax, Sept. 5, 1792.

[17] Andrew H. Clark. "Titus Smith Jr. and the Geography of Nova Scotia, 1801 and 1802". *Annals Assoc. Amer. Geogrs.* Dec. 1954, v. 44, 291-314.

[18] Public Archives of Nova Scotia. Lieut.-Governor's Petitions, 1847.

[19] Nova Scotia Crown Lands Office. Record Book No. 1, Statutes of Nova Scotia, 1851-52, ch. 4.

[20] Public Archives of Nova Scotia. Loose file on "Surveys".

[21] A. B. Warburton. "A History of Prince Edward Island". p. 51.

[22] Land Tenure in Prince Edward Island; Orders in Council (Imp.) 1767. Also *Ont. Hist. Soc. Papers*, v. 21, 31.

[23] John Stewart. "An Account of Prince Edward Island in the Gulph of St. Lawrence, North America". W. Winchester, London, 1806.

[24] J.C. Fitzgerald, editor. "Writings of Washington". U.S. Government Printing Office, Washington, pp. 23, 144. Also A. B. Warburton. "A History of Prince Edward Island"; p. 184.

[25] Henry Youle Hind. "Geology of New Brunswick". Prelim. Report, ch. 1. Queen's Printer, Fredericton, N.B., 1865.

[26] G.H. Hay. "A History of New Brunswick". p. 93.

[27] See Revised Statutes, N.B., 1952, v. 4, 5 (Imperial Order in Council establishing Province of New Brunswick).

[28] George Sproule Letter Books. vol. A (1785-89), 1. Public Archives of New Brunswick, Fredericton, N.B.

[29] ————————————, 325. Public Archives of New Brunswick, Fredericton, N.B.

[30] ————————————, 373. Public Archives of New Brunswick, Fredericton, N.B.

[31] Surveys Branch, Government of New Brunswick, Fredericton. (Charlotte 1-173) v. 19 of Applications, 1763-1793.

[32] George Sproule Letter Books; vol. A, 1. Public Archives of New Brunswick, Fredericton, N.B.

[33] Alexander Monro. "New Brunswick, Nova Scotia and Prince Edward Island". Richard Nugent, Halifax, 1855.

[34] See ref. note 15 above.

[35] D.W. Prowse. "A History of Newfoundland". p. 61. Macmillan and Co., 1895; also Eyre and Spottiswoode, London, 1896.

[36] Colonial Records (1814). Public Archives of Newfoundland, St. John's, Nfld.

[37] H.M. Mosdell. "When was that in Newfoundland". p. 143. Trade Printers and Publishers, St. John's, 1923.

[38] J. R. Smallwood, editor. "The Book of Newfoundland". v. 2, p. 12. Newfoundland Book Publishers Ltd., St. John's, 1937.

[39] Appendix to Journal of House of Assembly, Sixth Session (1836), Newfoundland. p. 193.

[40] Journal of House of Assembly, Sixth Session (1836), Newfoundland. p. 70.

[41] Appendix to Journal of House of Assembly, Sixth Session (1836), Newfoundland, p. 189.

[42] Original Registry, Public Archives of Newfoundland. v. 1, folio 2.

[43] D. W. Prowse. "A History of Newfoundland". p. 427.

[44] Appendix to Journal of House of Assembly, Sixth Session (1836), Newfoundland. p. 200.

[45] *Encyclopaedia Canadiana*. v. 3, 115.

[46] *Encyclopaedia Canadiana*. v. 5, 377.

[47] Journal of House of Assembly, 4th Session of 8th Assembly (1864), Newfoundland. pp. 10, 16.

[48] Report of Select Committee, House of Assembly (1869), Newfoundland. Murray Evidence.

[49] Appendix to Journal of House of Assembly (1869), Newfoundland. p. 713.

Chapter 13. EARLY PROBERS OF CANADA'S SEAS AND GREAT LAKES

[1] "Boke of Hydrography". British Museum, Royal Mss. 20 E 9.

[2] British Museum. K MAR 1 (41).

[3] Edward Wright. *Certain Errors in Navigation*: "Suppose a spherical superficies with meridians, parallels, rumbes, and the whole hydrographical description drawne therefrom, to be inscribed on a concave cylinder, these axes agreeing in one . . . In this nautical planisphere thus conceived to be made, of places must needes bee situate in the same longitudes and directions or courses, and upon the same meridians, parallels, rumbes that they were in the globe".

[4] Hakluyt Society, 1904, VII, p. 162.

[5] J. Barrow. "Voyages Into the Arctic Regions". Murray, London, p. 118.

[6] *Encyclopaedia Canadiana*. v. 4, 287.

[7] T. E. Layng. Sixteenth Century Maps Relating to Canada. Ottawa, 1956, p. 23.

[8] Dr. John Dee's Journal, 1583. Also see Albert H. Markham. "The Voyages and Works of John Davis the Navigator". Hakluyt Soc. 1880.

[9] F. J. S. Parsons and W. F. Morris. "Imago Mundi" III, 1939, p. 61.

[10] *Encyclopaedia Canadiana*. v. 3, 208.

[11] "The Voyages of Captain Luke Foxe of Hull and Captain Thomas James of Bristol in Search of a North-West Passage in 1631-32." Hakluyt Society. London, 1894. v. 2, 324. Miller Christy, Editor.

[12] Prof. Paper No. 13. British Admiralty. Hydrographic Dept. London. 1950, p. 67.

[13] Parry, 1821, p. 296.

[14] *Contr. Dom. Obs.*, Ottawa. v. 1, no. 3. Also: *Polar Record*, No. 43, 387, 1952.

[15] British Parliamentary Papers, 1850a, p. 58.

[16] Sir John Franklin. "Narrative. Second Expedition to Shores of the Polar Sea". 1825-27. v. 2, 65.

[17] Prof. Paper No. 13. British Admiralty. Hydrographic Dept. 1950, p. 72.

[18] Andrew Taylor. *Geog. Mem. 3*, Geog. Br., Dept. Mines and Technical Surveys, Ottawa, 1955.

[19] "A Voyage of Discovery to the North Pacific Ocean and Round the World". Narrative by Captain George Vancouver. (3 vols.) Printed for G. G. and J. Robinson and J. Edwards, London, 1798. See v. 2, chap. 6, 379. Point Wales is the west point of Observatory Inlet.

[20] Captain Cook and Captain King: "A Voyage to the Pacific". (3 vols.) See v. 2, 263. See also Little: *Can. Geog. J.*, June, 1962, p. 195.

[21] Prof. Paper No. 13. British Admiralty, Hydrographic Dept. 1950. p. 26. Chart no. A317-88.

[22] See Annotations by W. Bligh on his copy of the Cook and King "Narrative of the Third Voyage". British Admiralty Library, London.

[23] William Faden, Geographer to the King, published a Chart (undated but definitely after 1780) of the Northwest Coast of America and the Northeast Coast of Asia explored in the years 1778 and 1779. Prepared by Lt. Henry Roberts, under the immediate supervision of Captain Cook.
William Strahan, London, in 1777 published a Chart of the Southern Hemisphere. See frontispiece of vol. 1, Cook's "Narrative".

[24] Capt. Vancouver. "Narrative". v. 1, 18, 19.

[25] ———————— v. 1, 18 (Apr. 26, 1791).

[26] ———————— v. 2, 312 (June 22, 1792).

Canadian Historic Sites plaque, erected 1929, near U.B.C. campus: "The Last Spanish Expedition: In commemoration of the first friendly meeting of the British and Spaniards in these waters near this place Captain George Vancouver on June 22, 1792, met *Sutil* and *Mexicana* under Captains Galiano and Valdes, last Spanish exploring expedition on what is now the British Columbia coast. They exchanged information, established mutual confidence and continued exploration together".

[27] Alexander Mackenzie. "Voyages". 1801, p. 349.

[28] Capt. Vancouver. "Narrative". v. 3, 295.

[29] Pacific Northwest Quarterly. 41 (October, 1950), 356.

[30] Public Archives of Canada. J. F. W. DesBarres. 1774-1807 Corresp. Series 3, pp. 1-230 M.G. 23.

[31] Public Archives of Canada. J. F. W. DesBarres. 1774-1807 Corresp. Series 3, pp. 1-230 M.G. 23.

[32] Milo M. Quaife, editor. "The Siege of Detroit in 1763". The Lakeside Press. Chicago, 1958.

[33] Lieut. Charles Robertson of the 77th Regiment, who commanded the King's vessels on Lake Erie in the early 1760s.

[34] Fred Landon. "Lake Huron". The Bobbs-Merill Co. N.Y. 1944, p. 286.

[35] Lieut. Edward Chappell, R.N. "Narrative of a Voyage to Hudson's Bay in His Majesty's Ship *Rosamond*". R. Watts, London, 1817. pp. 175-6. Tables of Soundings 179-80-1. Compass Variations p. 247, Thermometrical Observations p. 249.

[36] James Fisher. "Rockall".

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[42] Capt. John Palliser. "Papers Relative to the Exploration of British North America". 1859, p. 4.

[43] Map with James Hector article: "On the Geology of the Country Between Lake Superior and the Pacific Ocean". *Quart. J. Geol. Soc. London*, v. 17, 1861, pp. 385-445.

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Names of the Expedition Party, July 23, 1857:

H. H. Killaly	Leveller
Ed Cayley	Chainman and General Assistant
C. De Salaberry	Chainman and General Assistant
J. Cayley	Assistant Leveller, Rodman
S. J. Dawson	Surveyor
Lindsay Russell	Chainman
G. F. Gaudet	Chainman
Mr. Campbell	Chainman
Prof. H. Y. Hind	Geologist
W. Fleming	Assistant
A. W. Wells	Assistant to Mr. Dawson
J. Dickenson	Engineer.

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[48] H. Y. Hind. "Narrative". 1860, pp. 233-36.
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[2] *Haldimand Papers.* Public Archives of Canada, MG 21, G2, v. 126, 1. British Museum, Add. MS 21775 (May 26, 1783).

[3] *Haldimand Papers.* Public Archives of Canada, MG 21, G2, v. 124, 34-5-7. British Museum, Add. MS 21784 (June 26, 1783).

[4] In 1780 Col. J. Butler obtained Haldimand's permission to divide suitable farmland along the Niagara River into lots for refugee Loyalists. Surveyor Allan MacDonell submitted to Quebec an account for payment covering his 24-day period of work at 10 shillings a day and including expenses for two chainbearers and one "marker". This undated document could represent the first record of a local land survey in what was to become Upper Canada. (See R. M. Anderson, *Development of Township Surveys in Ontario.* The Canadian Surveyor, April, 1936 issue, p. 6). By August, 1782, more than 230 acres had been cleared in the vicinity of Niagara for 16 settlers and their 68 dependents and it must be assumed that surveys were necessary for this occupation. By the autumn of 1783 at least 710 acres had been cleared in this area for the use of 46 families.

[5] *Haldimand Papers.* Public Archives of Canada, MG 21, G2, v. 124, 90. British Museum, Add. MS 21784 (June 26, 1783).

[6] *Haldimand Papers*. Public Archives of Canada. MG 21, G2, v. 126, 42. British Museum, Add. MS 21786, v. 2 (September 11, 1783).

[7] *Haldimand Papers*. Public Archives of Canada. MG 21, G2, v. 124, pp. 45, 46. British Museum, Add. MS 21784.

[8] Public Archives of Canada. R.G. 4, No. 25.

[9] Colonial Office, London, Eng., 42, v. 61, 179 (July 17, 1788).

[10] *Simcoe Papers*. Letter to Evan Nepean (April 28, 1792). Public Archives of Ontario, I, 146.

[11] General Instructions for Deputy Surveyors in the Province of Upper Canada 1792, v. 1. Also: Ontario Crown Lands Office (Toronto) records (October, 1792 to April, 1794).

[12] Field Notes of Augustus Jones (1793). Bk. 366, Surveys and Maps Office, Ont. Dept. of Lands and Forests, Toronto. See also: No. 1760, *Plan of Niagara, 1787*, by Philip R. Frey, Deputy Surveyor.

[13] Edith G. Frith. "The Town of York 1793-1815". The Champlain Society, Toronto, 1962. Also in the Public Archives of Canada, see Plan of Township of York, November, 1813.

[14] *Encyclopaedia Britannica*. 14th ed., p. 802, under "Without Benefit of Clergy".

[15] *Proc. Assoc. Ont. Land Surveyors* (1887), 129.

[16] Running the line of Dundas Street by A. Jones from Burlington Bay to the forks of the Thames (London) required a month (September 16 to October 17, 1792).

See: W. E. Breithaupt. "Dundas Street and Other Early Upper Canada Roads". *Ont. Hist. Soc. Papers*, v. 21, 8.

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[19] Watson's survey of the Richelieu River, 1792, is incorporated in the Plan of a part of (the) Province of Lower Canada made by order of Lord Dorchester in 1794-5 (Catalogue 289) and map of Sorel seigniory surveyed by him, 1795.

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[21] Secretary's letters 1824-25, Hillier to Talbot, p. 169. Public Archives of Canada (January 26, 1825).

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[12] Report of the International Boundary Commission (1937) "Gulf of Georgia to Northwesternmost Point of Lake of the Woods". Dept. Interior, Ottawa. Appx. Three, p. 194.
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[15] O. J. Klotz. "The History of the Forty-ninth Parallel Survey West of the Rocky Mountains". *The Geog. Rev.*, v. 3, no. 5 (May 1917).
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Volume 2
1867 to 1917

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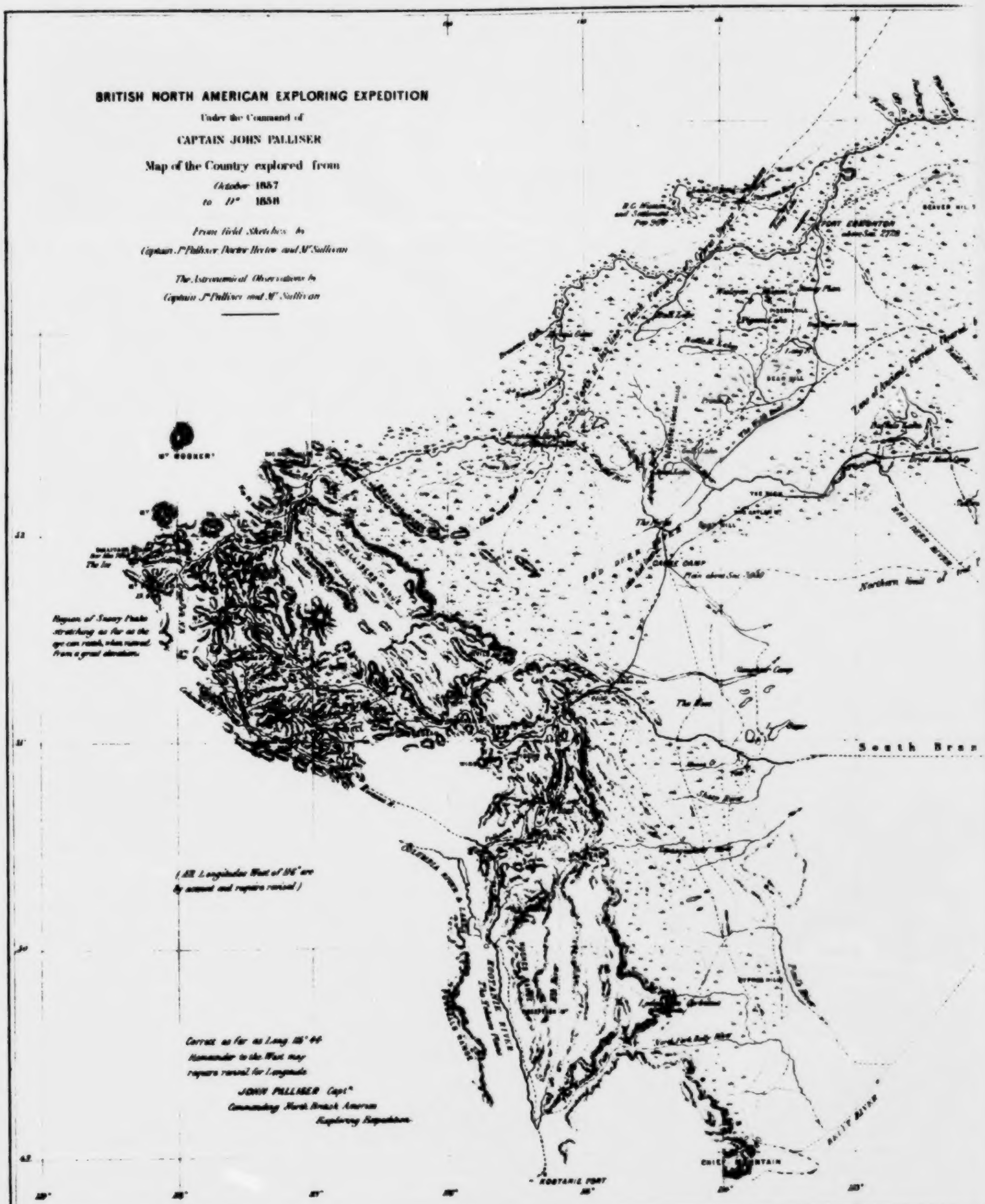
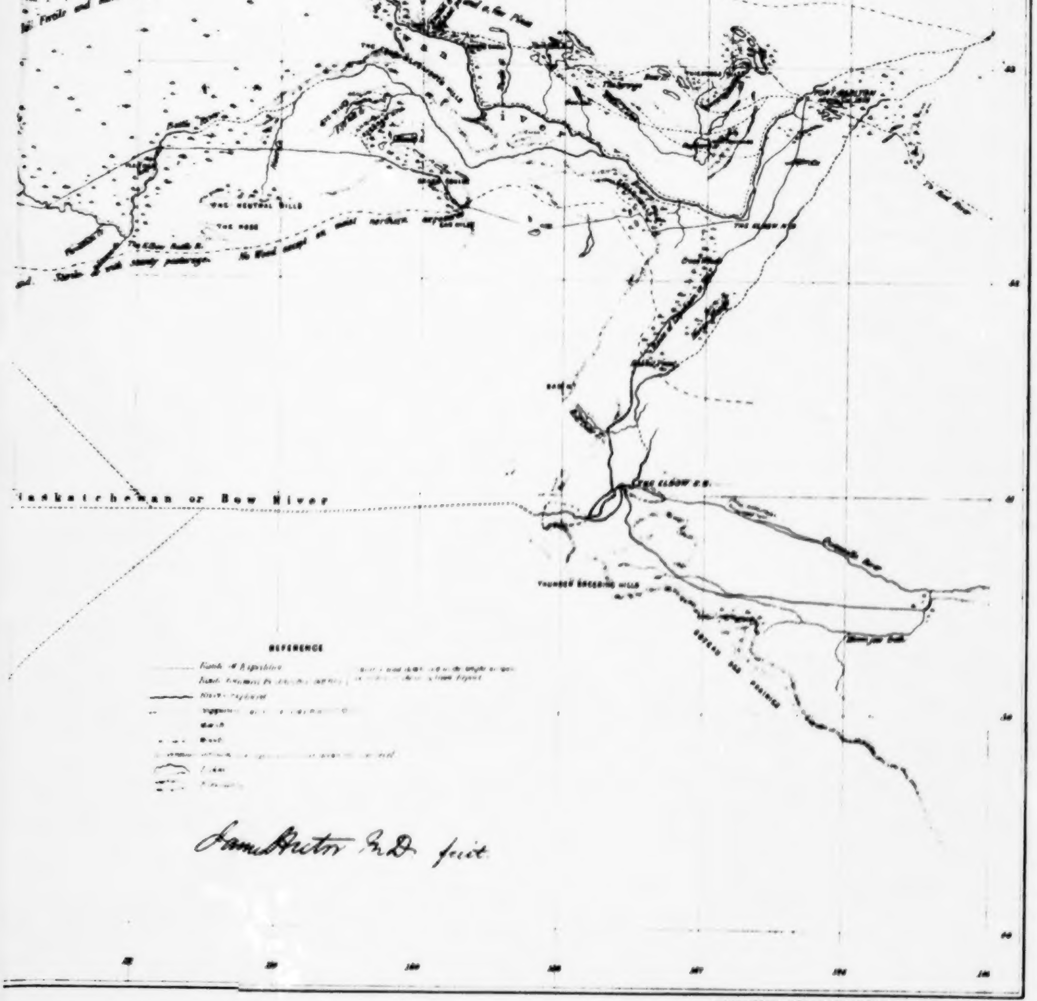

BRITISH NORTH AMERICAN EXPLORING EXPEDITION
Under the Command of
CAPTAIN JOHN PALLISER
Map of the Country explored from
October 1857
to D° 1858
From field Sketches by
Captain Jⁿ Palliser Doctor Hector and M^r Sullivan
The Astronomical Observations by
Captain Jⁿ Palliser and M^r Sullivan
M^t HOOKER
FORT EDMONTON
BEAVER HILLS
Range of Snowy Peaks stretching as far as the eye can reach, when viewed from a great elevation.
PALLISERS RANGE
RED DEER
Northern limit of
The Bow
South Bra
(All Longitudes West of 116° are by account and require revisal)
Correct as far as Long 115° 44
Remainder to the West may require revisal for Longitude
JOHN PALLISER Captⁿ
Commanding North British American Exploring Expedition.
KOOTANIE FORT
CHIEF MOUNTAIN
BELLY RIVER
KOOTANIE RIVER

MAP 1. Map of the country explored by Palliser Expedition, 1857-58. T



South Limit of the Thickwoods
Fertile and Rich. Vegetation luxuriant. Partially Wooded with
Saskatchewan or Bow River
THE ELBOW S.B.
THE NEUTRAL HILLS
THE NOSE
The Elbow Battle R.
Steppe with scanty pasturage.
No Wood except on small northern
THE ELBOW N.B.
THUNDER BREEDING HILLS
REFERENCE
Route of Expedition
Rivers explored
Lakes
James Hector M.D. fecit

rst accurate map link between the head of the lakes and the western interior.

Prefatory Note

Manitoba is the only Canadian prairie province possessing a sea coast. Thus geography was at least partly responsible for the relatively early association of the white man with this central part of Canada. So far as is known, Sir Thomas Button, the noted Welsh pioneer mariner, was the first white man to set foot on what is now Manitoba soil. From England he followed in 1612 the same route as Henry Hudson to the famous strait where Button discovered a small group of islands missed by Hudson on his ill-fated voyage two years before. The islands continue to bear the Welshman's name. In command of the *Discovery* (the same vessel used by Hudson) and the *Resolution*, Button crossed Hudson Bay to the mouth of a large river, naming it the Nelson in honor of his sailing master.

In the opening years of the last decade of the 17th century Henry Kelsey traversed what is now Manitoba from Hudson Bay to the Saskatchewan River, the first white man to view the prairies of the western interior. In 1738 Pierre de la Vérendrye was the first white man to reach the junction of the Red and Assiniboine rivers. The saga of this eminent French-Canadian explorer and his famous sons is the story of the opening of a new era of discovery and development in the West as far as the foothills of the Canadian Rockies.

Formal legal surveys on the prairies began 200 years after Button's landfall on the western shore of Hudson Bay. In 1811 the Hudson's Bay Company granted to Lord Selkirk a territory of 116,000 square miles, extending southward into what is now the State of Minnesota and described in the transfer documents as "Beginning of the western shore of Lake Winnipie, otherwise Winnipeg, at a point in fifty-two degrees and thirty minutes north latitude, thence running due west to the Lake Winnepigoos, otherwise called Little Winnipeg, then in a southerly direction through the said Lake so as to strike its western shore in latitude fifty-two degrees north, then due west to the place where the parallel of fifty-two degrees north latitude intersects the western branch of Red River, otherwise called Assiniboine River, then due south from that point of intersection to the Height of Land which separates the waters running into Hudson's Bay from those of the Missouri and Mississippi, then in an easterly direction along the said Height of Land to the source of the River Winnipie or Winnipeg (meaning by such last mentioned River, the principal branch of the waters which unite in Lake Saginagas), then along the main stream of the waters and the place of beginning."[1]

When the line of the international boundary was determined it was found that a portion of Selkirk's original domain was within the United States. To that extent, of course, the grant was inoperative. The term 'District of Assiniboia' was applied to that part of the initial grant laying within British territory. The 'Municipal' District of Assiniboia, according to regulations adopted on June 25, 1841, "extended in all directions fifty miles from the Forks of the Red River and the Assiniboine." In the 1830s the Hudson's Bay Company purchased from executors of the Selkirk estate all of Lord Selkirk's interests in the District.

On the original map of the grant there is a memorandum that reads: "Whereas the Surveys upon which this map has been drawn are not sufficient to ascertain with precision Whither Latitude 52° does intersect the River called Red or Assiniboine River, it is therefore agreed by and between the within mentioned Governor and Company and Thomas Earl of Selkirk that in case the Waters of Red River shall on more accurate Surveys be found not to extend so far North as Latitude 52° then the West boundary of the Tract of Land intended to be within granted shall be a Line drawn due North and South through the Post upon the said River marked on this Plan Carlton House the words 'Source of the said River' being deleted before delivery thereof."[2]

More accurate surveys showed clearly that the upper reaches of the Assiniboine River were below the fifty-second parallel and hence the description in the Memorandum applies to the western limit of the grant.

Miles Macdonnell led the first group of Selkirk colonists to Red River in 1811. By July 21, 1814 (a year before the defeat of Napoleon at Waterloo) a third group had arrived. It is reasonable to assume that these settlers were allotted parcels of land on a methodical basis and that this procedure entailed a system of survey. Earliest available records indicate that Peter Fidler was employed as a surveyor at £100 per year. In 1814 he laid out lots along the Red. In all, Fidler surveyed 36 lots that season. His next survey project involved,

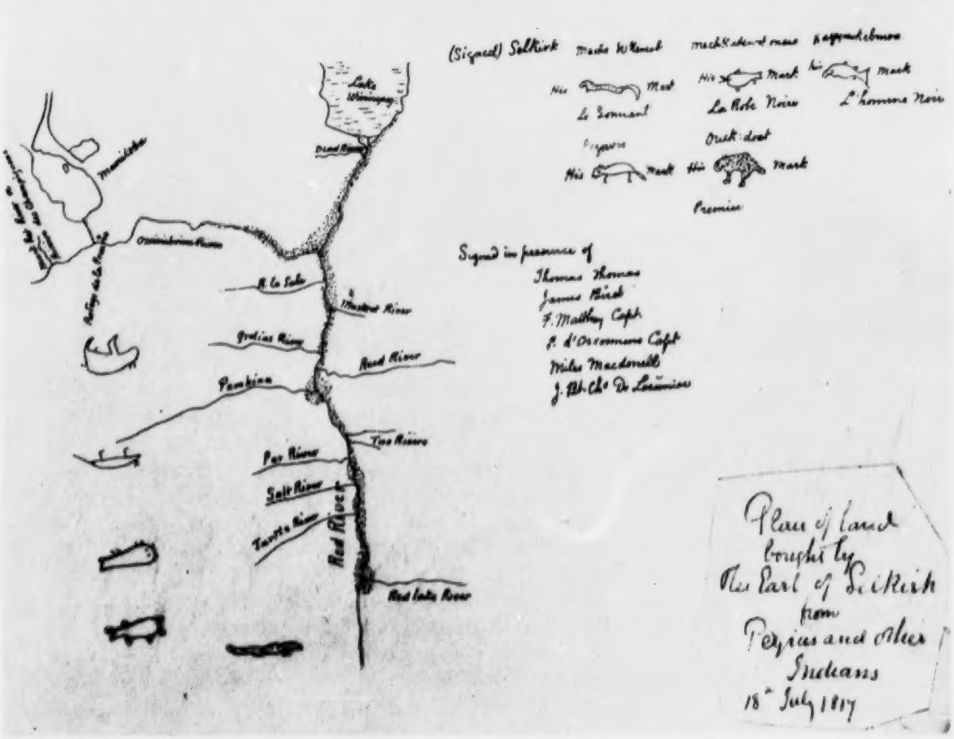

Lake Winnipeg
Manitoba
Assiniboine River
R. la Sale
Gratias River
Red River
Pambina
Two Rivers
Salt River
Red River
Red Lake River
(Signed) Selkirk
Le Sonnant
La Robe Noire
L'homme Noir
Ouek:doat
Premier
His mark
Signed in presence of
Thomas Thomas
James Bird
F. Matthey Capt.
Miles Macdonell
Plan of land
bought by
The Earl of Selkirk
from
Pegias and other
Indians
18th July 1817

FIGURE 1. Plan of land purchased by Lord Selkirk from Indians, July, 1817.

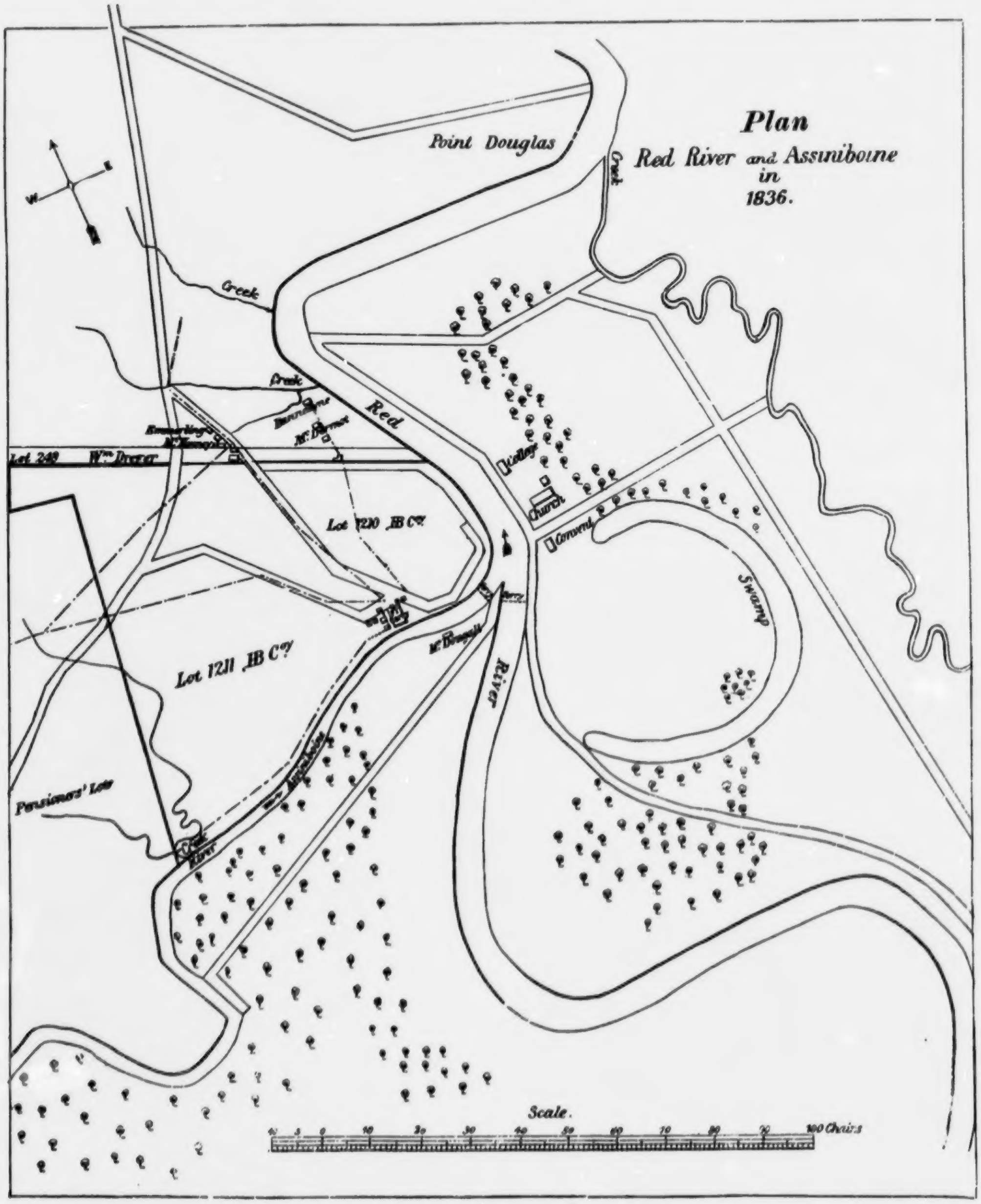

Plan
Red River and Assiniboine
in
1836.
Point Douglas
Creek
Creek
Creek
Red
River
Lot 249 Wm
Lot 1210 HB Co
Lot 1211 HB Co
McDermot
McDougall
Ferry
Church
Convent
Swamp
Pensioners' Lots
Scale.
10 5 0 10 20 30 40 50 60 70 80 90 100 Chains

FIGURE 2. Map of Red River Settlement drawn by George Taylor, surveyor, 1836.

in 1817, the sub-dividing of Point Douglas into lots. This made possible the settling of more than 100 soldiers brought to the Settlement by Lord Selkirk for policing purposes, and disbanded there.

According to John Halkett, Lord Selkirk's executive agent in the Settlement "each (lot) containing a few acres and bordering on the river, a wide street running from the open to the highway being set apart for their common use, affording access to the common which lay beyond the road on which the settlers on the point had the right of pasturage and hay making". Peter Fidler died in 1822.

A Scotsman, William Kempt, succeeded Fidler as surveyor in the colony and was paid £100 per year for this work. In 1822 Kempt laid out lots on Image Plain, some 10 miles north of Point Douglas. Each of 8 lots contained 32 acres. Governor Bulger said of Mr. Kempt that he was "surpassed by no man that I have ever known, in zeal and industry in the performance of his professional duties."

Following Kempt, George Taylor was engaged as surveyor from 1836 to 1844. Taylor made what is now known as the "Old Settlement Belt Survey" laying out 1,542 lots along the Red and Assiniboine. Taylor's plan formed the basis of all subsequent Hudson's Bay Company land grants in the Settlement. The original plan, in the fashion of so many other early documents, disappeared without a trace. A copy is in the possession of the Department of Indian Affairs and Northern Development, Ottawa. An inscription on the map reads: "Plan of the Red River Colony, copied from that in the possession of the Hudson's Bay Company. Surveyed in 1836-7-8, scale 50 chains to the inch." Although unsigned the plan is generally acknowledged to be the work of George Taylor. An 1836 map in outline shows a part of the Settlement in the vicinity of the Forks (Red and Assiniboine rivers) in 1836, according to Taylor. The original of this map is in the Provincial Library of Manitoba, Winnipeg.

In June, 1855, William Inkster was named Public Surveyor at a salary of £25 per year and was authorized to charge for every day he was employed, a sum not exceeding 7 shillings, sixpence per day. In May, 1856, the Council of Assiniboia decided that there ought to be two surveyors in the colony. Roger Goulet, born in the Settlement in 1834, was appointed to work in that part of the colony situated to the south of the Forks. A few years later Herbert L. Sabine was also engaged on similar terms to operate on the north side of the Red.

One of the by-laws passed at a council meeting in 1862 stated: "Messrs. Goulet and Sabine shall be surveyors for this Settlement without salary from the public funds but they shall be entitled to be paid 10 shillings per diem each by any person who calls for their services." The usual practice in laying out lots was to make them approximately two miles in depth or the Indian measurement of two miles, the distance bounded on a level plain by a horizontal line of sight made under the belly of a horse. Much would depend, therefore, on the build of the animal.

A peculiar class of claims to land, deserving of some notice at this stage, was known as "staked claims". From about 1860 some of the settlers had been in the habit of wintering stock along the relatively well-sheltered banks of the Seine, Rat and LaSalle rivers. Numerous claims of this nature were staked by the métis along the fronts of these three rivers. Quite often one man would stake several such claims for himself and his family.

Lieut.-Governor Archibald asserted in a report to Ottawa in 1870 that all the early systematic surveys, conducted under instructions of the Hudson's Bay Company, extended to some 150,000 acres in all, involving a division into approximately 1,550 lots, averaging 96 acres each, commonly the quantity of farmland contained in lots 6 chains in width (river frontage) and extending back 160 chains. In actual practice, however, it would appear (from other records) that the depth of cultivated lots was considerably less than that, and the width in some instances considerably more.[3]

Issued by the
Department of Energy,
Mines and Resources
(formerly Mines and Technical Surveys)

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NOTE: *By proclamation published in the* CANADA GAZETTE, *September 22, 1966, the Department of Mines and Technical Surveys was reorganized under the new title, Department of Energy, Mines and Resources, the change to have official force and legal effect as from October 1, 1966.*

1

CONFEDERATION AND THE RED RIVER SETTLEMENT

"You were the duke's surveyor, and lost your office on the complaint of the tenants:"
King Henry VIII, Act 1, Sc. 2.

Readers of the first volume of this history will recall that in the vanguard of the westward flow of European settlement in Canada during the 17th, 18th and 19th centuries were to be found pioneer surveyors and mappers, men indispensable to the sound, logical development of civilized communities and regions. By 1867 hydrographic survey work of basic significance had been carried out by the British Admiralty in the ocean entrances to British (continental) North America, both east and west. Land surveys had aided in the peopling and progress of Nova Scotia, New Brunswick and Prince Edward Island. Seigniory holdings had been laid out and subdivided into characteristic river-lot patterns along the banks of the St. Lawrence in French Canada. Much of Upper Canada from the Ottawa River to the Detroit Frontier and to lower Lake Huron had been the object of measurements and reports by land surveyors. These resourceful pathfinders had also established lines of highways and colonization roads. A good beginning had been made in the hydrographic surveys and the mapping of the Great Lakes. Much survey work had been accomplished in defining the Canadian-United States boundary from the Bay of Fundy to the North West Angle of the Lake of the Woods. Fundamental land surveys and road construction work had been carried out in British Columbia, mainly by the Royal Engineers. Only Canada's western interior, the prairie and parkland extending from the Red River to the foothills of the Rockies remained, for the time being, largely immune to the ever-advancing waves of newcomers and the onward sweep of white settlement.

At the time of Confederation few realized that Canada's western interior was on the threshold of formidable development involving, over the following four decades, an increase of population exceeding one and a quarter million and, in Manitoba alone, an increase approaching half a million. The purchase by the Canadian government of Rupert's Land heralded the approach of a new era in a region that soon came to be known as Manitoba and the North-West Territory and, much later, as Manitoba, Saskatchewan, Alberta and the Territories. This historic transaction also involved a drastic change in the way of life of many of the native-born inhabitants of the purchased territory. It meant the beginning of the end of a nomadic, carefree existence, particularly for the métis, mixed blood descendants of French-speaking Canadians and their Indian wives.

In the nature of things land surveyors were in the forefront of the impending influx, harbingers of the inevitable transformation of a land and its people. These pioneers of the chain and transit formed the advance guard of a vast host of property-hungry immigrants seeking new opportunities in life; a tiny group of trained men entrusted with the responsibility of preparing land boundaries in a pattern most suitable for the anticipated occupation and settlement. Indians in territories to the south had violently resisted encroachments by whites on what the native peoples regarded as their own domain. In Canada, Indians and half-breeds in areas tributary to the Red River Settlement and in the Settlement itself felt a deep and fully-justified fear that impending events would leave them aliens in a land that they and their progenitors considered their inalienable empire. These children of nature generally lacked the ability to adapt readily to new conditions. The routine of daily tasks, the necessity for being provident, for subordinating spontaneous pleasures of the flesh to the orderly demands of sustained industry; all these sober, if relatively dull, virtues were quite repulsive to these easy-going, freedom-loving extroverts. As long as the plains yielded ample harvests of buffalo meat, furs, fish and hay, their nomadic way of life was profitable, apparently secure and fully enjoyable. But the white man, with his acquisitive habits and ambitions and his lust for property with boundary lines protecting individual ownership, stirred feelings of distrust and even anger in the métis. These grim forebodings, together with the vagueness surrounding the perpetuation of Indian and métis claims to the lands on which they habitually wintered, created profound misgivings among these unsophisticated peoples of the plains. At about the same time the terrible depletion of buffalo herds, the growing scarcity of fur-bearing animals accompanied by a series of crop failures in the Settlement area continued to expedite the very changes the native peoples abhorred but somehow could do nothing to prevent.

Added impetus was given to the flow of immigration to the western interior of Canada by the cereal experiments of David Fife (1804-77) a farmer located near Peterborough in Canada West. In the mid-19th century Fife produced a new hard spring wheat strain, later known as Red Fife, that gave promise of developing into a high-yield grain on the fertile prairies. What was urgently required, however, was a wheat variety not only rich in protein but capable of maturing early enough in a land of limited rainfall to escape damage from early frosts, always a hazard of the region. It was not until some years later that the first substantially successful answer to this critical problem was found in Marquis wheat, discovered in 1904 by Charles E. Saunders (later Sir Charles) assisted by his brother, Arthur. Red Fife was one of the parents of the crossbreed that resulted in Marquis. The Marquis seed, widely distributed to Western farmers in 1909, served to open up millions of prairie acres to the cultivation of wheat.

Sir John A. Macdonald's satisfaction on July 1, 1867, over the accomplishment of Confederation would have been tempered somewhat had he possessed on that historic day the clairvoyance required to read correctly the immediate future of Canada. Here was a new nation brought into being by a combination of British support, American hostility and Canadian need. Despite his far-sightedness on some highly important issues of his day, Macdonald was spared contemplation in advance of the painful experiences that rapid national development would soon entail. From 1867 to 1871 Canada and its national government was called upon to endure and surmount a series of political crises. During this dangerous period not only the cherished hope of a nation stretching from coast to coast trembled in the balance but also the continuity of the newly-born English-French collaboration in government. In the damaging collision and subsequent slow reconciliation of aims and ambitions following the somewhat clumsy annexation by Canada of the western interior, land surveyors and their surveys played a prominent, provocative yet wholly indispensable role.

Expansion was taking place in areas other than the strictly political. The western world had entered a new economic age of steam and steel. By mid-century railways had begun to appear in the Canadian provinces. This development meant not only a new field for surveying activity but an increase in industrial enterprise generally in the areas served by them. By 1860 several hundred miles of track had been laid in the Maritimes and slightly more than 2,000 miles in the Province of Canada. The advent of railways, with the accompanying enlargement of trade and settlement horizons, led to strategic decisions of a high order. Doubtless the appearance of railways in North America helped turn attention to Canada's North West as a new land of opportunity. In part the growth of popular interest in the region was due to a desire to contain American expansionism towards the west and north of the continent. In addition, much of the good farmland of Upper Canada, or Canada West as it was officially known, had been occupied, whereas the western plains offered a vast empire of fabulously fertile acres. Minnesota's advance to statehood signalled the dynamism and direction of westward settlement in the United States. Minnesota became a state in 1858 and two years later claimed a population exceeding 170,000. Some Americans were beginning to examine the possibilities of incorporating within the United States the thinly populated areas of what was later to become the province of Manitoba.

As the frontier of American settlement moved swiftly and inexorably across the interior of the continent British and Canadian concern over the ultimate destiny of Rupert's Land mounted. This anxiety was not in the least allayed by the realization that as a result of its Civil War (War between the States) the United States of America had become a formidable world military power.

Such was the situation in the North West in particular and North America in general during the years immediately after Confederation. Sir John A. Macdonald was sufficiently far-sighted to realize that union of the four provinces in the East would need to be followed by an expansion of Canada into the vast and potentially rich North West if that extensive territory was to continue under the British flag and connection. Also it would be necessary to annex Rupert's Land in order to construct a rail link with British Columbia. The United States, caught up in a mood of buoyant expansionism, made no effort to disguise the fact that it was aiming to control as much of the middle west of the continent as it could absorb. It was a period of ambitious railway building in the United States also. Rails of steel were rapidly penetrating the West in the wake of railway surveyors, bringing what appeared to many Canadians as a serious threat of an extension of United States sovereignty north of the 49th parallel of latitude.

Sir John felt that he and his administration were engaged in a desperate race against time and the Americans, and that the stakes involved in this international competition were of the highest significance. Macdonald's policy vis-a-vis the West was two-pronged. First, to proceed with all possible speed to bring into Confederation the western interior north of the 49th parallel; second, to bring about the early construction of a transcontinental railway to serve the interior and to help maintain its British character and to make possible as well the entry of British Columbia into the Canadian union. It was this vision of a Canada extending from

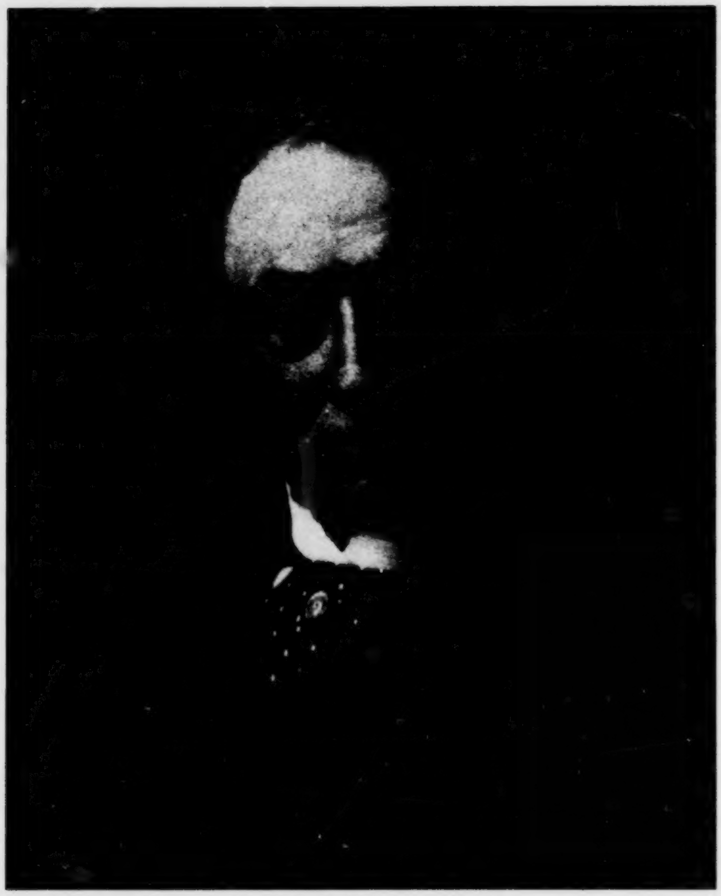

FIGURE 3. Sir John A. Macdonald

the Atlantic to the Pacific that made Sir John unique among Canadian statesmen of his time.

On December 4, 1867, the initial step was taken by the newly-formed Government of Canada to bring the Midwest into Confederation. Hon. William McDougall (1822-1905) Minister of Public Works, a prominent spokesman for national expansion and widely known for his keen interest in the North West, introduced in the House of Commons, Ottawa, a series of resolutions. These were intended as a basis for an Address to the Crown asking for the transfer of Hudson's Bay Company territories to Canada. In July, 1868, the Rupert's Land Act was passed at Westminster. The date originally set for the formal transfer was October 1, 1869, but difficulties over financial arrangements resulted in a postponement of the date to December 1, 1869.[1] A second postponement brought about serious unforeseen repercussions.

Another important move by the Canadian government following Confederation, in anticipation of annexation of the western interior, was that of undertaking the provision of a road-and-water link between Canada and the Red River Settlement (Fort Garry). Simon James Dawson (1820-1902), a Scottish-born civil engineer, experienced in conditions of the region, was called in to supervise the survey and construction of this line of communication. Dawson had been appointed by the government of the Province of Canada in 1851 to plan and to superintend construction of works on the St. Maurice River in order to open up timber reaches on that river and its tributaries. In 1857 Dawson was appointed to explore the country between Lake Superior and the Saskatchewan River and to report on its suitability for settlement. Now, in 1869, Dawson's services were again requisitioned by government and he commenced work on what was later to become widely known as the "Dawson Route".

In the autumn of that same year McDougall sent John A. Snow with a small party of Canadians to Red River Settlement to commence road surveys and road construction on the western terminal portions of the Dawson Route. The Minister of Public Works, in taking this praiseworthy action, committed two rather serious errors. These missteps marked the beginning of a long series of blunders committed by Ottawa officialdom in carrying out federal government policies concerning the North West, and helped to make inevitable a dangerous clash of wills and of interests on the banks of the Red. Although the western interior, Rupert's Land, was still owned and controlled by the Hudson's Bay Company, McDougall failed to observe the fundamental niceties of the delicate situation. As representative of the Government of Canada, McDougall failed to apply formally to the Company for its permission for the party to enter the western region for the purpose of carrying out the instructions given them. The Company protested this conduct but allowed the work to proceed.[2] Snow, the surveyor associated with the construction of colonization roads in Upper Canada, did his best to remedy the oversight by approaching Hudson's Bay Company officers in the Settlement for their retroactive approval of the operation.

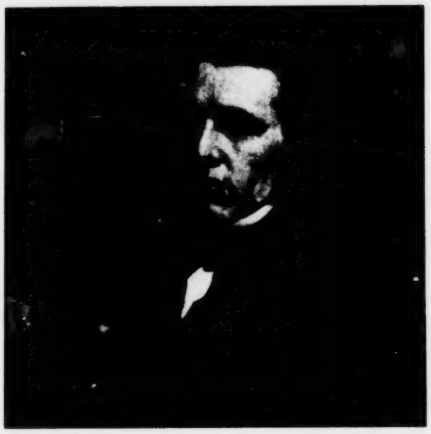

FIGURE 4
Hon. William McDougall

McDougall erred again when he attached Charles Mair to Snow's party as paymaster of the road crew. Mair, a personal friend of McDougall, was a native of Lanark village near Perth and had attended Queen's University. A poet of some prominence Mair was strangely insensitive to the depths of feeling and the strong motivations of the métis of the plains. Mair's ignorance and tactlessness in this area were surpassed only by his articulate enthusiasm for large-scale settlement of the West by Canadians from Ontario. Mair proved to be a major troublemaker during the tense period when political storm clouds hovered low over Canada's awkward acquisition of Rupert's Land.

What manner of man was McDougall, the individual mainly responsible for turning road and settlement surveys into such a contentious issue during this critical stage of Canada's national development? William McDougall was born at York (Toronto) on January 25, 1822, of United Empire Loyalist stock. In his late teens McDougall showed a marked talent for journalism. Aggressive in temperament and action he soon developed into a trenchant writer and made a name for himself in the newspaper and magazine field in Upper Canada. In addition he took training in the law and qualified as a solicitor in 1847. He was called to the bar in 1862. Possessed of an erect, commanding figure and a clear, sonorous voice, McDougall made rapid headway also in colonial affairs, entering public life in 1858. From 1862 to 1864 he was Commissioner of Crown Lands. Elected for North Lanark in 1863 he was invited, as one of the Fathers of Confederation, into Sir John A. Macdonald's cabinet in 1867 as Minister of Public Works.[3] At that time federal land surveys came under the jurisdiction of the Department he headed.

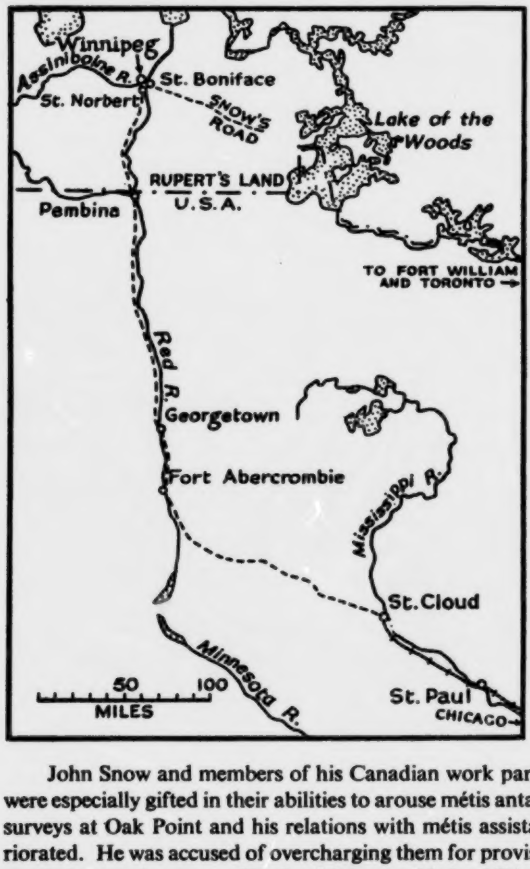
Winnipeg
Assiniboine R.
St. Boniface
St. Norbert
Snow's Road
Lake of the Woods
RUPERT'S LAND
U.S.A.
Pembina
TO FORT WILLIAM AND TORONTO →
Red R.
Georgetown
Fort Abercrombie
Mississippi R.
St. Cloud
Minnesota R.
St. Paul
CHICAGO
50
100
MILES

FIGURE 5
Railway approach to Red River country, 1869. Note projected route of John A. Snow's road.

John Snow and members of his Canadian work party, one of whom was Thomas Scott, were especially gifted in their abilities to arouse métis antagonism. Snow began his initial road surveys at Oak Point and his relations with métis assistants on the road crew speedily deteriorated. He was accused of overcharging them for provisions and for making underpayments on their stated wages. Charles Mair provided additional complications by striking up a close friendship with Dr. John Christian Schultz (1840-1896) (later Sir John), a physician and storekeeper in the Settlement. Born in Amherstburg, Schultz was educated at Queen's and Victoria (Cobourg) Universities.[4] Tall, powerfully built, intelligent and well-travelled, Schultz was a natural leader of elements in Red River Settlement favorable to the annexation of Rupert's Land by Canada. In time he became Lieut.-Governor of Manitoba (1888-1895) after serving in the House of Commons for 11 years and 6 years in the Senate. Like Mair, Schultz seemed bent on coming into conflict with those of the native-born population of the Settlement whose mother tongue was French.

There were other complaints against Snow and his associates from Canada. The métis fiercely resented efforts by Schultz, Snow, Mair and others to stake out for themselves lands near the Settlement for purely speculative purposes. This type of activity occurred at Oak Point and the métis claimed that the lands so staked were, in fact, their own. There were charges also that the Canadians were plying Indians with liquor to help induce them to sell lands to them. Archbishop Taché of St. Boniface testified to this effect before a committee of the House of Commons.[5] Incidents such as these helped to fan into flames the prejudices and fears of the native-born population, emotions and passions long smouldering because of continuing uncertainty over what would happen to them and their lands when the transfer of the North-West Territory to Canada finally took place.

McDougall, despite his blunders of 1868, had an opportunity to mend matters the following summer when he instructed Lieut.-Col. John Stoughton Dennis, P.L.S. (1820-85)* of Weston, Ontario, to proceed to Red River district and, after examining the area, recommend a system of surveys for that region. On this occasion permission to proceed with the project was formally sought in advance from the Hudson's Bay Company. One of Dennis's first acts on arrival in the Settlement was to call upon the Governor of Assiniboia, William Mactavish, senior Company official in that community.

En route to Fort Garry by way of the United States, Dennis interviewed S. G. Davidson, Surveyor General of Minnesota and General Nutting, a former Surveyor General of that State; Dennis also obtained information by correspondence with Hon. J. S. Wilson, Commissioner of the United States General Land Office. From these eminent Americans Dennis gained considerable insight into the theory and application in western areas of the States of the rectangular system of land surveys.

Dennis also acknowledged indebtedness to "Mr. Russell, Assistant Commissioner and Mr. Devine, Chief of Surveys of the Ontario Department of Crown Lands, for valuable information and suggestions."

Dennis was careful to obtain proper instruments for survey work in the North West and addressed himself to McDougall by letter in mid-July in the hope of securing ministerial aid in this connection.[6] Dennis found that instruments purchased by Snow from Potter, a Toronto supplier, were for the purpose of "noting atmospheric phenomena exclusively" and Dennis asked McDougall for authority to buy more instruments, although deputy surveyors would be expected to provide themselves "with a good theodolite transit". He pointed out, however, that it would be advisable to have a set of instruments that would remain the property of the Government. Out of this set Dennis himself proposed to use "a theodolite or transit" of a type that would be "thoroughly reliable in fixing the Meridional and Base lines which, in all probability, will govern the system of future surveys in that country". Dennis further pointed out that Potter had such an instrument, an "Altitude and Algimuth Transit Theodolite" for sale. Apparently this instrument had been imported for a Mr. Hawkins, P.L.S., for astronomical observations and cost $300. In spite of the fact that the transit had been used to a limited extent only, Dennis felt it could be bought for $125 or less.

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*Following political union of Upper and Lower Canada in 1840, surveyors qualified to practise in the new Province of Canada were entitled to add the initials P.L.S. (Provincial Land Surveyor) after their names. Dennis had so qualified in 1842 and had served continuously on the Board of Examiners from 1852.

He indicated to the minister that the following instruments would also be required: "an artificial horizon ($25); a good level ($80); a good field glass ($25); a supply of drawing instruments, protractor, scales, rules, etc.; a box of colors; a supply of drawing and tracing paper, stationery; a nautical almanac and tables and "one small seat for myself ". The cost of these miscellaneous items Dennis considered trivial.

This was an impressive start. But from the moment of his arrival in August in the Red River Settlement, Dennis's visit was ill-starred. The earnest and diligent surveyor did his best to avoid making errors of omission. He called upon the "right people" in the locality to explain the nature of his mission. Subsequent happenings revealed that even his presence in the Settlement at that particular time was premature. To the dissident elements the fact of his arrival spoke far more eloquently than any of his words, no matter how reassuring these might appear to be. In any event powerful forces were at work, locally and nationally, the nature and dimensions of which rendered Dennis's conciliatory efforts completely abortive.

Even a figure of the stature and leadership potential of Louis Riel was caught up in forces and events that proved well beyond his power to shape or effectively control. In July, 1868, Riel, like Dennis more than a year later, had arrived in the Settlement from Minnesota. Unlike Dennis he was not a newcomer to the place. Born 25 years earlier on the banks of the Seine (a tributary of the Red) this intense young man, son of Julie Lagimodière and Louis Riel, was destined to become one of the most fascinating, yet one of the most tragic, human figures in the long and eventful sweep of Canadian history. Louis' father was the son of Jean-Baptiste Riel, voyageur, and his wife, Marguerite Boucher, of Franco-Chipewyan blood. Julie, mother of Louis and daughter of the first white woman to reside in the North West, was a silent but deeply affected witness during the years of her son's stormy career as he became first, an outlaw, then an exile and, finally, a victim of the gallows in the land of his birth. Despite an unstable temperament, Riel, by the depth of his convictions, his educated eloquence and ability to win and hold a following, proved to be a natural leader. He possessed an almost mystical faculty for attracting dynamic elements in the primitive West to support, against considerable odds, some highly abstract political aims and objectives.

On the same day McDougall was appointed Lieut.-Governor of the North West (September 28), his commission to take effect "on and after the transfer", instructions were issued by the Secretary of State for the Provinces, Hon. Adams G. Archibald, asking McDougall to proceed "with all convenient speed" to Fort Garry to superintend preliminary arrangements for the organization of the new territory. McDougall moved swiftly enough. On the day of his conditional appointment he left Ottawa for his "kingdom" as Sir John A. Macdonald smilingly called the minister's new area of responsibility. As the train pulled away from the station, Sir John waved farewell to his colleague.

Dennis had intended that his survey party should consist of Mr. McGrath, P.L.S. of Ottawa, Milner Hart, P.L.S. of Brantford and himself. McGrath, however, took ill and was unable to join Dennis in Toronto, on the 27th of July as arranged. Prior to leaving Toronto Dennis was joined by "five gentlemen who had obtained permission to accompany my party through to Fort Garry, *paying their own expenses*" (author's italics). At St. Paul a disappointed Dennis got the word that McGrath would not be able to make the trip West at all. Dennis then wrote to Major A. C. Webb, P.L.S. of Brighton "in whom I have every confidence" to join him at Fort Garry without delay.

The most prominent participants in the drama about to be enacted had arrived on stage or were gathering in the wings. Few observers, however, were prepared for a spectacle in which this federal venture, marked by so hopeful and auspicious a beginning, would end in circumstances amounting to a near fiasco. One important actor managed to remain for a time in the background of events, performing (from his point of view) a heroic role without attracting too much official attention in Canada. He was James W. Taylor, by turns an American Consul lobbyist and undercover man. In the Settlement at Red River, which he visited often, he represented without ostentation the interests of United States annexationists. American agitation at the time in support of a takeover of the troubled Settlement by the United States, was centred in St. Paul. Even prior to the transition period in the Canadian North West the annexationists had powerful voices in their own nation advancing their cause. In 1867 Secretary of State William Seward stated publicly, "I know that Nature designs that *this whole continent*, not merely these 36 states, shall be sooner or later, within the magic circle of the American union."[7]

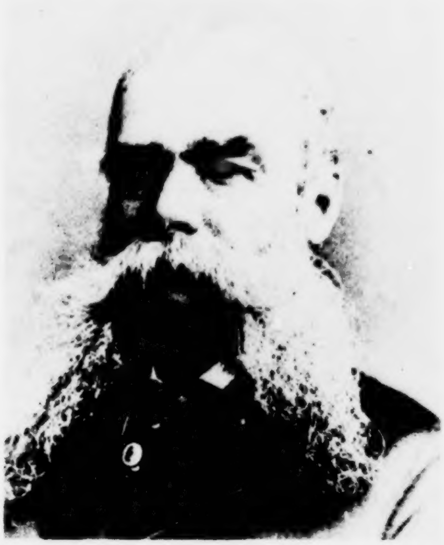

FIGURE 6
Lieut.-Col. J. S. Dennis, Surveyor General of Canada, 1871-78.

Taylor's subversive activities in Manitoba and elsewhere began, in time, to alarm Canadians. But in the end the sheer intensity of his propaganda efforts served to defeat his own purposes. Sir John A. Macdonald, blessed with a perceptive mind and large vision, grasped the principal danger and moved to thwart it, "The Hudson's Bay question must soon be settled; the rapid march of events and the increase of population on this continent will compel England and Canada to come to some arrangements respecting this immense country."

Following the successful negotiations in London, England, by Sir George E. Cartier and William McDougall, the Canadian Parliament passed a measure, given royal assent on June 22, 1869, providing a temporary government of Rupert's Land upon its union with Canada. The question of organizing the surveys of the western interior next had to be considered and dealt with. McDougall, as a former Commissioner of Crown Lands in the Province of Canada, was familiar with basic principles and aspects of public lands administration. As minister of the department having authority over, and responsibility for, federal surveys, he moved quickly. On July 10 he issued instructions to Dennis "to proceed without delay to Fort Garry, Red River, . . . to select the most suitable localities for the survey of townships for immediate settlement . . . to report the plan of survey proposed for adoption . . . and until receipt of notice of its approval or modification to proceed with such surveying operations at Oak Point and the vicinity of Red River as may appear to be necessary in any event."

Following his enquiries in the United States Dennis made his way to Fort Garry, arriving on August 20. He committed the tactical error, however, of arriving in the partisan company of Dr. Schultz. Immediately, therefore, Dennis was off on the wrong foot so far as Riel and the militant métis were concerned. In fact Dennis was not long in the Settlement when he began to be alarmed. In spite of his best efforts to establish a basis of understanding with leaders in the Settlement, he failed to make any real headway in the pit-strewn field of conciliation. He began to realize that his survey mission had not been helped by his open association with Schultz. This development together with the fact that he was, in the eyes of the métis, "English from Toronto" rendered him *persona non grata* with them. Dennis had heard of Riel's impassioned and provocative address to church-goers in St. Boniface after Sunday morning mass. In some haste he wrote to Ottawa to advise McDougall "of the considerable degree of irritation existing among the native population in view of the surveys and settlements being made" and particularly among the métis who "have gone so far as to threaten violence should the surveys be attempted to be made."[8] In this sentiment Dennis was echoing the sentiment of Governor Mactavish who had given reluctant permission for the land surveys, "It is unfortunate that any survey should be commenced until the Canadian government was in authority here, as the whole land question is fruitful of future trouble which it will take much time and great labour to settle. I expect that as soon as the survey commences the half-breeds and Indians will at once come forward to assert their right to the land and possibly stop the work till their claim is satisfied."[9]

Dennis continued to work conscientiously on the commission given him by McDougall and on August 28, 1869, forwarded by mail an outline of a proposed system of surveys and subdivision of lands in the West along with suitable illustrative sketches.* What, then, were the contents of the historic initial Dennis recommendations for long-range and large-scale western settlement? He submitted four principal points of his plan:[10]

"1. The system to be rectangular; all townships to be east and west or north and south.

"2. The townships to number northerly from the 49th parallel of latitude and the ranges of townships to number east and west from a given meridian, this meridian to be drawn from the 49th parallel at a point say ten miles west of Pembina, and to be called the Winnipeg Meridian.

"3. The townships to consist of 64 squares of 800 acres each, and to contain in addition 40 acres, or five per cent in area in each section, as an allowance for public highways.

"4. The townships on the Red and Assiniboine Rivers where the same had ranges of farm lots laid out by the Hudson [sic] Bay Company, to be surveyed, the broken sections abutting against the rear limits of such ranges, so as to leave the same intact as independent grants."

It is interesting to note here that this plan resembled the American rectangular system of survey in its basic pattern but was considerably larger in over-all size. Townships in the Dennis proposals would be 8 sections square rather than the prevailing American arrangement of six by six. Sections would contain 800 acres each, making them about 1.12 miles square instead of the traditional one square mile.

In the Settlement Dennis had been joined by two other Ontario surveyors of good professional reputation, Milner Hart, P.L.S. and Major A. C. Webb, P.L.S. Dennis, after submitting his report to Ottawa, decided not to wait for an answer, as the survey season was getting on. In any event Dennis had authority from McDougall to proceed, pending approval, with any surveys he considered necessary. With Hart and Webb working under his direction, Dennis began laying out the Winnipeg or Principal Meridian, the initial line designed to govern surveys west and east on the wide plains, the meridian mentioned in his August recommendations.

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*Map on Mercator's Projection, illustrating the proposed division into townships of a part of the Territory. Plan of a township showing the proposed method of subdivision.

By a series of careful observations for latitude to determine the position of the 49th parallel (Canadian-United States boundary), including chainage from the astronomical station at Pembina, Dennis commenced from a point thus established to another point on the 49th parallel 10 miles west of Red River. From that point he produced the Winnipeg Meridian northward to the Assiniboine River. Hart carried the meridian line as far as Township 11 then turned westward on the base between Townships 10 and 11. Major Webb produced the base line between Townships 6 and 7 east of the Principal Meridian.

Dennis's warning to McDougall had been a wise move on the surveyor's part. But it had gone unheeded in Ottawa. This neglect was just another error which McDougall would soon have cause to bitterly regret. Eventually, early in October, 1869, Dennis was instructed "to proceed with the survey on the plan proposed."[11] But Dennis had good reason to be cautious and he did not attempt to continue surveys from Oak Point as originally planned. He moved his crews south, as we have seen, where surveying activities would not be observed by métis often enough to disturb them. But the period of deceptive calm was about to end.

On October 11 when his party was operating slightly east of the Principal Meridian, Webb and his men were approached by a group of métis from the Settlement, headed by Louis Riel and Baptiste Tourond. The métis had become disturbed when they caught sight of these surveyors approaching an area of settlement and begin to run their lines over the "hay privilege", as the lands to the rear of the long, narrow river lots had come to be known. When Webb and his men arrived on the hay lands of André Nault, Riel and his associates made their historic, fateful move.[12] The métis were content merely to stand on the surveyors' chains and so prevent further prosecution of their work. There were no threatening words or gestures. Major Webb quietly departed from the scene with his men and equipment.

The action of the métis was a bold one and constituted the first overt act in the campaign of resistance to the importation not only of a whole new government for the region but an entirely new way of life for many in that domain. The act on the Nault farm signalled as well the beginning of a period of violence and near-violence in the Settlement over the impending transition and transformation in Western life and affairs. The time for brooding and argument was over: the time for action had come. In later days whenever Riel was queried about the need for this confrontation with the surveyors he would explain that the Canadian government had no right to make surveys in the Territory without the express permission of the people of the Settlement.[13]

Distressed over the obstructionist gesture by the métis, Dennis complained to Dr. Cowan, magistrate at Fort Garry. But neither his efforts nor those of Governor Mactavish or of the local surveyor, Roger Goulet, were effective in dislodging Riel from his hostile position. Federal surveys did not cease entirely, however. Hart had continued to produce the Principal Meridian up to Township 11. Then he turned west on the base line between Townships 10 and 11 but soon encountered Shoal Lake. Accordingly he returned to the meridian and, beginning on a line between Townships 9 and 10, produced it west across Range 1. Turning north Hart then produced the meridian between Ranges 1 and 2 to Shoal Lake. After the incident of October 11th, Hart spent the remainder of the season running exterior lines of townships between the Principal Meridian and the Red River, north of Township 8.

Webb's party was withdrawn under instructions to run "the exterior line of townships north of the Assiniboine and east of the Meridian to the Red River and to complete the same to connect up with the lines being run by Mr. Hart and then go on with the survey of settlement among English-speaking settlers along the Assiniboine."[14] Dennis observed at the time that the English-speaking people appeared "to understand and appreciate the necessity for the measuring and the boon it would be to have their titles perfected" and that they showed "every facility to the surveyors". With a view to economies, the survey parties, after finishing the work on township lines, were reduced by the release of horses and carts and by limiting party personnel to the surveyor in charge, two chainmen, two flagmen and two axemen and packmen, seven in all. In the winter weather the men got subsistence from farmhouses. By December 1st all field work was discontinued when the tempo of political developments began to increase. Federal surveys did not resume until

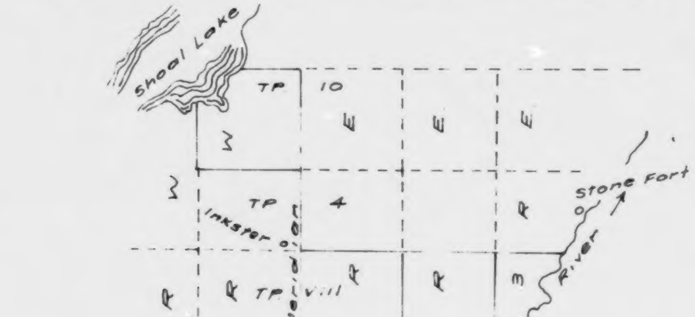

Shoal Lake
TP 10
E
E
E
W
W
TP 4
Inkster
Meridian
Stone Fort
R
R
R
R
R
R
3
River
TP VIII
Red
2
2
TP VII
Assinniboine
River
Fort Garry
T VII
River
Le Sal
Winnipeg
Note
The hard Lines are those which have been run
10 M.
Pembina

FIGURE 7. Principal (Winnipeg) Meridian and related lines surveyed in 1869 as depicted on page of Milner Hart's field book.

1871. During the 1869 survey season a total of 182 miles of meridian lines as well as of township exteriors had been drawn on the ground and marked by posts and mounds at quarter sections. A total of 20,000 acres of settled farms was surveyed along the Red and Assiniboine rivers.[15]

Dennis, during October, had commenced compiling a map of the country between Lake of the Woods and Fort Ellice and from the international boundary north for 125 miles, "to be lithographed in order to facilitate further surveys." He had intended to show on this map the projected townships in accordance with the recommended and approved system, indicating the method of providing for convergence of meridian lines. When nearly completed, work on this map was interrupted on October 30th by the eruption of serious political troubles in the Settlement. Dennis managed to prepare a plan on a scale of 60 chains to the inch showing Hudson's Bay Company grants on the Red and Assiniboine rivers; also a township plan on a scale of 40 chains to the inch as well as two finished tracings of Hudson's Bay Company maps depicting land grants recorded by the Company.

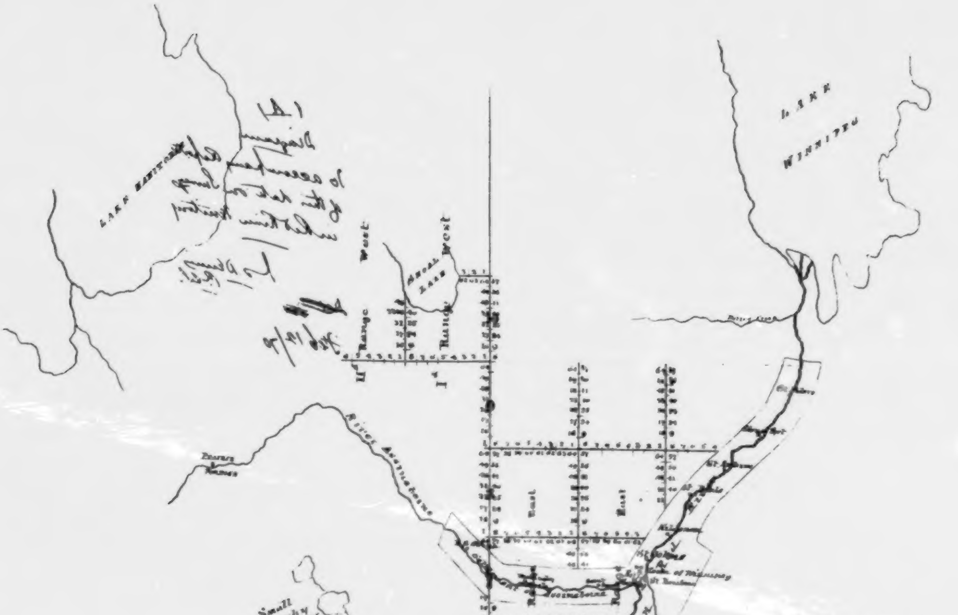
On the day that Major Webb's party was halted McDougall and his entourage from Ottawa detrained at St. Cloud, Minnesota. McDougall, on the dubious advice of Dennis, had taken with him 350 rifles and 30,000 rounds of ammunition. Word of this shipment quickly reached Riel. His response was definite and immediate. On October 16 at St. Norbert a National Committee of the métis was formed and Riel was named its secretary. Five days later an ultimatum addressed to McDougall was drawn up: "Le Comité-National des Métis de la Rivière Rouge intime à Mr. William McDougall l'ordre de ne pas entrer sur le Territoire due Nord-Ouest sans une permission spécial de ce Comité." (The National Committee of the Métis of Red River orders William McDougall not to enter the Territory of the North West without special permission of the above-mentioned Committee.)[16]

Upon McDougall's arrival at the United States customs post at Pembina, the frontier village located just south of the international boundary some 70 miles from Fort Garry, the ultimatum was delivered to him by a métis courier. McDougall angrily disregarded the warning and continued on his journey to the Hudson's Bay Company post two miles to the north. Attached to the staff of the Lieut.-Governor Designate was Capt. D. R. Cameron, son-in-law of Sir Charles Tupper, one of McDougall's cabinet colleagues. It was intended that Cameron would receive appointment to a high post in the new administration of the Territory, once it was formed. McDougall, however, came to consider Cameron as uncooperative—a "Sir John A. Macdonald man". Soon they were to quarrel and to shun each other's company.

After the encounter with the courier Capt. Cameron tried to force his way past a métis road barrier at St. Norbert but was accompanied back to Pembina by an escort of métis horsemen.[17] McDougall was subjected to a similar display of force. On November 2 a métis mounted patrol visited McDougall at the Hudson's Bay Company post and ordered him out of the Territory. McDougall complied very reluctantly. The Lieut.-Governor Designate had been thrust out of the land he had hoped to administer in the name of the Queen.

A section of the United States press was elated over this dramatic turn of events and made the most of McDougall's discomfiture and humiliation. The St. Paul *Press* in an editorial in its November 4 issue employed ridicule . . . "A King without a Kingdom is said to be poorer than a peasant . . . without one poor foot of territory is a spectacle sufficiently sad to move the hardest heart."

Despite Riel's patrols the English-speaking Canadians in the Settlement were in regular communication with McDougall. Snow and Mair pleaded with him quite unwisely as subsequent events proved, not to retreat from Pembina. They assured him that the English-speaking element would rise on his behalf if only called upon authoritatively to do so. The


LAKE MANITOBA
LAKE WINNIPEG
West
West
Ist Range
IInd Range
River Assiniboine
East
West
Small Marshy Lakes
Winnipeg Meridian
RED RIVER
Marsh Lake
Rough Diagram
Based on Hind's Map, intended to illustrate Report of this date on Township Surveys - Red River Territory.
Ottawa Feb 12th 1870
J. Stoughton Dennis
P.L.S.
~~Pembina Dec 9th 1869~~
Note
It will be seen that the Townships number North from the 49th Parallel and lie in Ranges East and West of the Winnipeg Meridian - J.S.D.
Scale of 6 Miles to the Inch
Sketch of Township Showing numbering of Sections
Boundary
Line
49° N. Lat.
J.S.D.

MAP 2. Diagram of the commencement of Dominion Land Surveys, with the establishment of the Winnipeg (Principal) Meridian line, Red River Territory, 1870, drawn by J. S. Dennis.

month of November proved to be a tedious and trying time for McDougall as he paused in frustration on the threshold of his "Kingdom". Mactavish showed good judgment in advising McDougall at this juncture to return to Canada.

All this time a pattern of government conduct was being woven at Ottawa that would soon form a rug with which McDougall's feet would be figuratively swept from under him. On November 23 Sir John A. Macdonald, much disturbed over the reports from the North West, wrote to his close friend and confidant, partner in a private banking firm in London, England, John Rose (later Sir John), and who had served briefly as Minister of Finance in Ottawa. "I fear", wrote the Prime Minister, "that the people that McDougall sent up there, Snow, Mair and Dennis have not helped at all to smooth matters." Macdonald's view of the situation was that McDougall was instructed to proceed to Fort Garry to make preliminary arrangements for the organization of a government of the Territory *on hearing of the transfer of that region to Canada*. Until officially notified to that effect he was *not* to assume the function of Lieut.-Governor but to act as a private individual. In fact, in a letter to McDougall the Prime Minister had urged McDougall *not* to force his way into the North West but to let those in the Settlement know where he was (author's italics). Macdonald suggested in a letter to McDougall that "the (clever) Riel be retained as an officer of your police . . . as a proof that the half-breeds generally were not to be left outside the law . . . " "The course taken by Stoughton Dennis in pressing for strong measures to be taken against parties interfering with his surveys was exceedingly injudicious. He is a very decent fellow and a good surveyor, and all that, but he has got no head and is exceedingly fussy. He was in the country simply on sufferance, in anticipation of its future transfer to Canada; on finding any serious dissatisfaction amongst the natives or residents, he should have at once struck work and awaited your arrival. It is, of course, important to have land surveyed for settlement as soon as possible, but that is a secondary consideration of your entrance on your duties with the general assent and support of the people . . . ".[18]

On November 26, within a week of the previously fixed date of transfer, the Prime Minister cabled Rose: "Canada cannot accept the North West until peaceable possession can be given. We have advised the Colonial Office to delay issue of Proclamation . . . meanwhile money (£300,000 to H.B.C. as purchase price) should remain on deposit but not paid over." Granville advised Gladstone, "We could not force the territory upon Canada, if they put up their backs."[19]

Thus the December 1 date for the transfer of Rupert's Land became null and void. With the slowness of the mails in those early days of the West and the lack of any speedier communications with Pembina, McDougall remained quite unaware of this major revision of government plans. Dennis was not content to remain idle. In view of the delicate complexities and the high stakes involved it would have been wisdom on his part to have remained inactive during November and December. Dennis had been ordered out of the Territory by the métis on November 2 along with McDougall and his party. He remained with McDougall at Pembina until November 29. On that bitterly cold night he rode to Fort Garry to make public there a Proclamation issued in the Queen's name by McDougall, dated December 1, on the mistaken assumption that he would be, on and after that date, in fact and in law, the chief executive authority in the North West. Dennis arrived at his destination at 5 a.m. on the 30th. He had been appointed by McDougall "Lieutenant and Conservator of the Peace in Rupert's Land" and he meant to carry out instructions.

In a revealing memorandum submitted to the Minister of Public Works in Ottawa some time later, Dennis stated: It may be asked:

"1. Why, when I was sent to the Territory to take charge of surveys, I left to go to Mr. McDougall at all!

"2. Why I did not return, after seeing Mr. McDougall, and continue with my surveying operations? I answer as follows—

"I acted entirely from *a sense of duty* as the only officer or representative in any way of the Canadian government at the time in the Settlement, to prevent, if possible, a threatened outrage on the person sent to the Territory with a commission as Lieut.-Governor, which sense of duty was enhanced by the fact that as Minister of Public Works the same gentleman had, up to that time, *given me all my orders*—and from him also, as told me by himself, I was to receive all future orders in the event of his being appointed Lieut.-Governor. It was a time of much excitement—Mr. McDougall's life was endangered and time was pressing—with Governor Mactavish's warning dispatch I raced on horseback from Fort Garry at 3 a.m. October 30, and by detouring the camp of the malcontents rode through to Pembina to meet McDougall on the morning of November 1. It was necessary to allow the exhausted horses several days to recuperate . . . I acted in good faith throughout *not being aware* until December 23 while on my way to Canada that the Proclamation and Commission issued by Mr. McDougall *under a misapprehension of the facts* (the transfer of the Territory not having taken place on December 1st as supposed) were worth no more than *waste paper.*" (author's italics).[20]

McDougall's blunder in issuing the Proclamation prematurely made his own position in the entire dispute not only untenable but exposed to harsh criticism. The only possible advantage gained for the Canadian case by his move was the widening of the wedge between English-speaking half-breeds and the métis. Riel had tried mightily for months to close this breach. From his point of view substantial unity of the two elements in the Settlement was essential to the success of the case against Ottawa.

Under his commission from McDougall, Dennis had authority to "raise, organize, equip and provision a sufficient force" including available surveyors and their assistants to deal with armed men unlawfully assembled to disturb the public peace. Dennis, however, failed to rally to his side any considerable number of the English-speaking half-breeds and a total force of not more than three-score were enlisted. Dennis decided, therefore, to retire with his tiny army to Lower Fort Garry, some 20 miles down river from the Settlement. He had failed also to induce Schultz and his band of 48 men to leave the Schultz residence and join the Dennis garrison. Riel and armed métis, thoroughly aroused and prepared for any eventuality, compelled Schultz and his following to surrender, marching them through the snow to Fort Garry where they were imprisoned. The debacle was completed when, two days later—on December 9—Dennis ordered his men at the Lower Fort to lay down their arms and disperse.

Now it was Riel's turn to issue a Proclamation and in the document he recited the reasons for métis intransigence. On December 10 the flag of the provisional government of the Territory, a fleur-de-lis on a white ground, appeared over Fort Garry.

McDougall took one more step to salvage something from the collapse of his ambitious project. He wrote to Riel on December 16 but in the absence of any response he, Dennis and Snow departed disconsolate from Pembina two days later. By way of St. Paul they began the long journey back to Canada. In his correspondence with Rose, Prime Minister Macdonald observed with considerable exasperation, "McDougall and Dennis have done their utmost to destroy our chance of an amicable settlement with these wild people, and now the probability is that our Commissioners (Thibault, De Salaberry and Smith) will fail and that we must be left to the exhibition of force next spring."[21]

The probability became a certainty as the spring of 1870 approached. As Macdonald had feared the efforts of his special commissioners, Thibault and De Salaberry, proved fruitless. A third emissary, Donald Smith (chief Hudson's Bay Company official in Montreal),

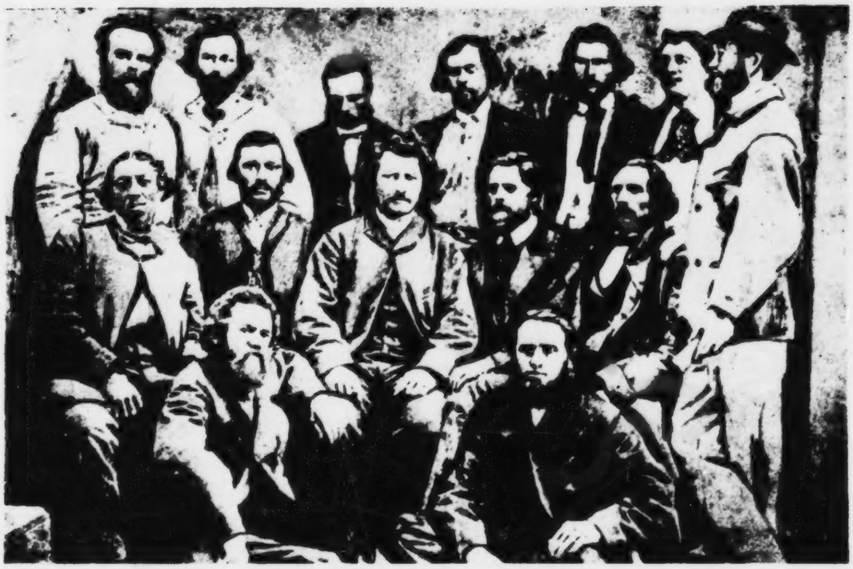


FIGURE 8. Louis Riel and his Council, 1869-70. *Standing:* (left to right) Le Roc, Pierre De Lorme, Thomas Bunn, Xavier Page, Andre Beauchemin and Baptiste Tereaux (Tourond?). *Second row:* Pierre Poitras, John Bruce, Louis Riel, W. B. O'Donoghue, François Dauphinais and Thomas Spence. *Seated in front:* Bob O'Lone and Paul Prue.

sent out to the Settlement in mid-December, made greater headway. Smith made a praiseworthy contribution to the cause of conciliation in an open-air address to a crowd of 1,000 at Fort Garry in below-zero temperatures. But the execution of Thomas Scott, one of Snow's work crew, on March 4 at the Fort under Riel's adamant orders, erased all hopes for measures by Ottawa short of a show of force in the Territory.

Macdonald was now fully convinced that a military expedition was essential as an assertion of Canadian authority and as a gesture of support of elements in the colony favorable to an early takeover of Rupert's Land by Canada. In this conviction Macdonald had the backing of Cartier. Two days after Scott's execution London cabled Ottawa promising British cooperation in any military mission to the North West. Col. (Sir) Garnet Joseph Wolseley, at the time a deputy quartermaster-general stationed in Canada and a veteran of the Crimea and of the Indian Mutiny, was appointed head of the expedition. Eventually he rose to the rank of field marshal in the British Army and in 1884-5 commanded the expedition to relieve Khartoum, including a considerable number of Canadian voyageurs to help in the navigation of the Upper Nile River.

The force placed under Wolseley's orders was of a mixed British-Canadian character. It consisted of 373 officers and men of the (British) 60th Rifles as well as militia units from Ontario and Quebec numbering 389 in all, supplemented by small detachments of Royal Artillery, Royal Engineers, Army Service Corps and Army Hospital Corps. On May 14 troops embarked at Collingwood for Sault Ste. Marie. By June 23, 1870, the last of the troops had arrived at Thunder Bay on the steamer *Arctic*.

In the meantime Dawson and his men had been laboring strenuously to prepare the road and water route out of Port Arthur for the expedition. Early in January, in fact, Dawson had been instructed to have a road ready by May 1st to admit the passage of horses and wagons.[22] The idea of providing a feasible route from Lake Superior to the Red River by land and water was not abandoned by the Government of Canada after Confederation in spite of the difficult nature of the country it was to traverse. But it never did prove to be a popular line of communication. Work on the Dawson Route commenced at its eastern terminus, Port Arthur, in 1867. Attached to Dawson's party was a young surveyor, Lindsay A. Russell, destined in time to become Surveyor General of Canada. J. F. Gaudet and Alexander Wells served as engineers.

The very first federal surveys to disturb the métis of the West were those under Snow designed to expedite the completion of the Dawson Route and thus eliminate any confusion that might otherwise attend a flood of immigrants. The Dawson Route was developed also as a matter of national policy to keep the flow of settlers moving within the boundaries of Canada.

By June, 1871, when the route was officially opened, a cart road from Thunder Bay to Lake Shebandowan, a distance of 45 miles, was reported to be in excellent condition by the federal Minister of Public Works. The road from Lake of the Woods to Fort Garry, some 95 miles, was passable. The 310 miles of broken navigation was made easier for travellers by the use of steamers. The fare for immigrants covering the journey from Thunder Bay to Fort Garry was $25. Freighting charges were fixed by Order in Council.

But a year earlier, when the greatest pressure for the use of the route was being exerted, the outlook was less promising. Forest fires and heavy rains had combined to delay construction work and by May 25, when Col. Wolseley arrived on the scene, only about 30 miles of road had been built. Throughout June and the first half of July men of the military units labored with Dawson's crews in an all-out drive to put the route in usable shape. The state of the road and some of the difficulties encountered in its building are contained in the account of an observer attached to the expedition:

"The road, properly so-called, does not extend far beyond the Matawin; the remainder, up to the Oskondaga, was intended to serve the purposes of the moment, and has not yet been ditched or treated according to the rules presented for road-making. When I passed over it six weeks ago, it was only partially cleared; the weather was dry; no wheels had gone over it and it afforded easy, pleasant walking. Wheels have now cut up the soft moss with which it was covered, the frost has come out of the ground, the rain has soaked in and, being in a valley, the traffic has churned it up until mud ponds and boulders combine to stop the way . . . The road beyond (the Oskondaga bridge) is very good. About four out of six miles are now ready for traffic . . . "[23]

Notwithstanding the general condition of the road the expedition made progress. Iroquois Indians and the whole force of the 60th Rifles were employed in levelling and draining. Other misfortunes struck hard at the expedition. Out of 150 horses sent to Thunder Bay, some of them for use with the artillery, 60 fell sick. No veterinary surgeon had been attached to the force. Disgusted with continual delays involved in overland travel Wolseley decided to rely on the waterways, so plentiful in this region of Canada, as far as Lake Winnipeg. From thence he travelled up the Red River from its mouth. By August 24 the force had reached Point Douglas, two miles from Fort Garry. Riel viewed its campfires that night and, alarmed by the appearance of the expedition so soon and so near his own headquarters, fled in great haste from Fort Garry to safety in the United States.

Meanwhile, the Manitoba Act had been passed by the Canadian Parliament on May 20 and on that same day Hon. (Sir) Adam George Archibald (1814-92) had been appointed

Lieut.-Governor of Manitoba and the North West Territories.* Later he served a term as Lieut.-Governor of Nova Scotia, his native province. As the first Lieut.-Governor in Canada's western interior Archibald laid the foundations of civil institutions of Manitoba and the territories. In order to take the post he had resigned from the portfolio of Secretary of State for the Provinces. Actually this federal cabinet office passed into history on July 1, 1873 when it was abolished (36 Vic. Ch. 1, Sec. 14). Hon. Joseph Howe was the last minister to occupy that position. On July 1, 1870, the long-postponed transfer of Rupert's Land to Canada was consummated by formal legislative action. On July 15, Manitoba formally entered Confederation.

Archibald reached Fort Garry on September 2 and on the following day the regular troops of the Wolseley expedition departed, their mission accomplished without a shot fired in anger. One unhappy incident marred the early days of the Archibald régime. Elzéar Goulet who, unlike his brother Roger, the surveyor, was an active supporter of Riel, was recognized on the street as a prominent rebel. He was chased by two militiamen and a civilian and in order to escape their fury, tried to swim the Red River. He was drowned in the attempt.

Under heavy pressure of other problems, including arrangements for taking a census of the new province, Archibald was delayed in making his study of the situation related to land surveys policy in the West. But on December 20, 1870, he forwarded his recommendations to Ottawa. Archibald, like Dennis, urged upon federal authorities that the rectangular system be adopted but disagreed with the surveyor over what was the most suitable size of township, section, and quarter-section. Archibald strongly advocated the American pattern of a 6-mile square township subdivided into 36 units of one square mile each, with a further subdivision into 4 square lots of 160 acres each. That system, Archibald pointed out, had been "adopted by the most practical people in the world and after 70 years' experience remains unchanged" and, he asked, why should we change it?

If events in the North West had taken a different course in 1869 and if McDougall had made a peaceful and successful entry into the Territory, it is entirely possible that the Canadian township would have remained at the initially recommended 64 sections, each 800 acres in size with an additional 40 acres for highway allowances (53,760 acres in all) and with 200-acre quarter-sections—the whole two and a third times the area of the present 36-section township (23,040 acres in all), and with the acreage of each section one-quarter as large again as in the existing 640-acre section.

McDougall had failed ingloriously in his enterprise and the reputation of Dennis was definitely not enhanced by the startling events of 1869. Riel, triumphant for a time, nevertheless after the execution of Scott began a gradual descent from his place of power and influence in the Settlement in 1870 to the gallows at Regina 15 years later. McDougall's career continued in the relative shallows of federal politics but Dennis recovered sufficiently in prestige and respect to enable him to occupy with distinction very high and very useful positions in the public service of his country until his retirement in 1881. Archibald, the new, duly-installed and able vice-regal representative in Manitoba made recommendations to Ottawa that met with favor in high places and in large measure constitute the basis of the pattern of land division in effect in the western interior ever since.

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*Following 1870 and until 1906 "North-West Territories" was the form of title commonly used in Canadian statutes. The unhyphenated version, "Northwest Territories" was introduced in the 1906 revision of Ch. 62 and has since been in general use.

2

EARLY SURVEYING AND MAPPING IN THE UNITED STATES

A knowledge of the story of surveying and cartographic developments in the United States is indispensable to a proper understanding of the history of settlement in Canada's western interior. The surveying practices in the United States have profoundly influenced the manner in which Canada applied principles of geometry to the task of subordinating large-scale physical geography to individual human needs. For many decades Canada and the United States have worked in constructive partnership to achieve the accurate completion of surveys and maps in a variety of fields, including hydrographic, geodetic, topographic and international boundary measurements as well as in outer-space studies. For this reason also a broad understanding of the American experience is vital to a sound grasp of certain Canadian decisions and trends.

Some of the more notable leaders of public opinion in the United States during the first hundred years of its nationhood were at one time or other in their careers either practising surveyors or closely linked with land survey and mapping activities. Washington, Jefferson, Franklin and Lincoln were interested in these fields to an extent not generally realized. George Washington (1732-99) wrote a book (unbound) in 1749 entitled *Early Survey Exercises* containing chapters, for example, on Geometrical Definitions, Surveying, the Art of Measuring Land, and Geographical Definitions. Forty years before he became first President of his country, Washington was actively surveying land. In 1749 he became, in what is now the United States of America, the first registered county surveyor (Culpeper county, Virginia).

In his diary Washington records on April 5, 1769, that he "Ran the back line of Spencer and Washington's Patent; and came home to Dinner." Again, on November 19, 1770, the following diary entry occurs: "At Ft. Pitt I got the distances from place to place down the Ohio as taken by one Hutchings* and which are as follows w' some corrections of mine."

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*Thomas Hutchins (1730-89) was captain of the 60th Foot or Royal American Regiment of the British Army. In the Revolutionary War he joined the colonists and was a captain and geographer in the Continental Army. He later became Chief Geographer of the United States.

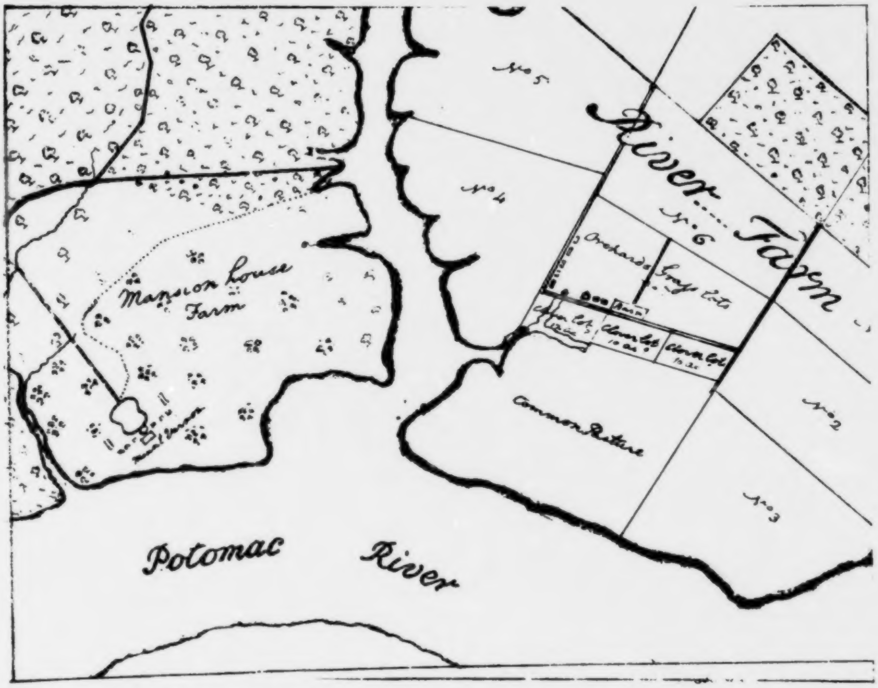

FIGURE 9. Mount Vernon estate, Virginia. Part of map drawn in 1793 by George Washington, based on his own surveys.

Visitors to Mount Vernon may view a map of that historic estate, drawn by George Washington and based upon his own surveys of the family property. His knowledge of terrain and of its significance in military operations taught him the value of reliable cartographic information. In 1777, as General of the Army, Washington established a central mapping corps with approval of Congress, the first federal mapping agency to be created in the States.[1]

In the pioneer stages of map making in the United States the name of James Wilson (1763-1855) looms large. This farmer-blacksmith of Bradford, Vermont, concluded at the age of 37 that he wanted to construct globes. In the first years of the 19th century globes were obtainable only from Europe and at a very high cost. Wilson sold some of his livestock in order to purchase an encyclopedia from which to gain information on cartography, mathematics, geography and astronomy. He learned copper engraving work from Amos Doolittle, one of America's first map makers. Wilson made all his own tools, mixed his own inks and prepared his own adhesives and varnishes. At one stage of his development in this exacting field Wilson worked 300 days engraving map sections on copper plate only to find that meridian lines were not converging properly. Accordingly he had to begin the operation all over again. He sold his first globe in 1810 and he became an immediate success. Subsequent Wilson globes sold at fifty-five dollars a pair.

As early as 1760 surveyors were occupied in locating on the ground the boundary between Maryland and Delaware. Between 1763 and 1767 this line was verified by two

English mathematician-surveyors, Charles Mason and Jeremiah Dixon. These men also established the Maryland-Pennsylvania border popularly known as "the Mason and Dixon line".[2]

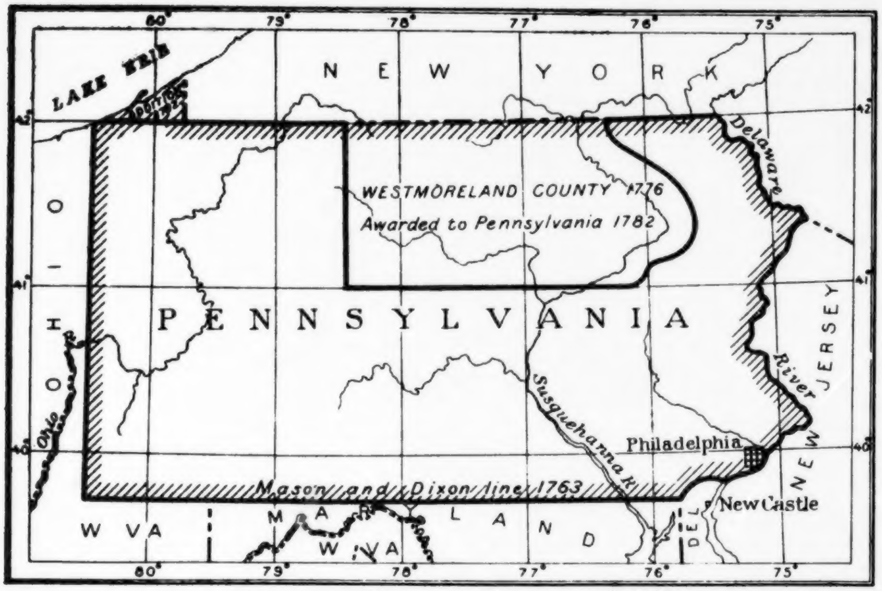
80°
79°
78°
77°
76°
75°
42°
41°
40°
LAKE ERIE
NEW YORK
OHIO
WESTMORELAND COUNTY 1776
Awarded to Pennsylvania 1782
PENNSYLVANIA
Delaware River
NEW JERSEY
Susquehanna R.
Ohio R.
Philadelphia
New Castle
Mason and Dixon line 1763
W VA
MARYLAND
W VA
DEL
50 0 50 100 MILES

FIGURE 10. Mason-Dixon Line, one of the best-known surveyed lines in the western world.

Peter Jefferson, father of Thomas, was a land surveyor, as was Peter's grandfather. Thomas Jefferson (1743-1826) was appointed Surveyor of Albemarle county, Virginia, in 1773, the same county in which his father practised.[3] Jefferson, with Hugh Williamson of North Carolina (a former professor of mathematics), gave strong leadership to a committee of Congress that worked to produce a suitable system for surveying public lands. The committee recommended the adoption of the rectangular system and this plan was approved and incorporated by Congress in the Land Ordinance of 1785. Under this system township areas were made six miles square and every township was divided into 36 sections of 640 acres each. This plan became the standard basic pattern for measuring and apportioning public lands throughout most of the new territories of the expanding nation.

The three major stages in the creation and growth of the United States rectangular land-survey system may be cited as the Land Ordinance of 1785; the pioneer surveys of the Seven Ranges and the Land Act of 1796. The Seven Ranges (townships laid out south of a line running due west from a point on the Ohio River) are noteworthy in the history of the United States public domain as the first proving ground for the application of principles set forth in the 1785 Ordinance. The east boundary of Ohio, north of the Ohio River, known as Ellicott's Line, in longitude 80°32′20″ was used as the first reference meridian. From this meridian the ranges were numbered progressively westward and the townships progressively northward from the Ohio River in each range.[4]

After he became President of the United States in 1801 Jefferson pressed for the active exploration and mapping of the trans-Mississippian West. It was during his presidency also that the agency known as the Survey of the Coast was inaugurated and the famous Lewis and Clark expedition to the Pacific Coast was undertaken. Another notable development in this period occurred in April, 1812, when the General Land Office was brought into being in Washington, D.C. Edward Tiffin was appointed first Commissioner of the General Land Office and was authorized to prepare and issue land patents as well as to keep all records of public land transactions. Tiffin is credited with founding the first system of federal land management.

Later on in the development of the United States another president, Abraham Lincoln, could claim among other accomplishments, training as a land surveyor. Lincoln spent six highly formative years (1831-37) "among other things, traversing Sangamon County (Illinois) as deputy surveyor."[5] Lincoln had mastered, in a relatively short time, survey text books, the use of chains, circumferentors and horizons. One of the books he studied was *The Theory and Practice of Surveying* by Robert Gibson, published in 1814. For his field work in surveying Lincoln was paid at the rate of three dollars a day.[6]

As a blazer of witness trees and a carrier of surveyors' chains Lincoln contributed to the opening up of a new land to settlement and progress. But by the stroke of a pen after he became President, Lincoln made an immensely more significant contribution to the development of the United States. Hordes of prospective settlers came to the States during the first half of the 19th century. In the Old World men dreamed of free land in the New. Dancing constantly before their eyes were visions of boundless expanses of uncultivated, ownerless and richly fertile acres. On both sides of the Atlantic men nursed the assumption of an inherent natural right of individuals to a part of the then apparently unlimited supply of virgin land. The very existence of such land invited the appearance of squatters, men who located on land without first acquiring title thereto. This condition also provided momentum to popular agitation for free homesteads.

Between 1801 and 1854 Congress, recognizing practical difficulties in any attempts to control the practice of squatting, passed a series of laws regularizing preemption by individuals on public lands. Each successive law and series of regulations concerning squatting became more and more liberal until in 1854-55 preemption by individuals was permitted even ahead of survey! But the law did require an eventual nominal payment for the land before full title to it was issued.

The earliest United States federal land grants to help promote the construction of railways were made by Congress in 1850. The Illinois Central as well as the Mobile and Ohio were initial beneficiaries to the extent of millions of acres. This generous example set the pattern for subsequent and even more extensive land grants to railway corporations. The largest was a 20-million-acre grant to the Northern Pacific. During a period of several decades land grants authorized by Congress for such purposes were made to some 70 railway systems to a total of more than 90 million acres.[7]

Free grants of land, particularly to individuals, seemed to be the logical solution at the time to the problem of settling the American West. This policy, in fact, became the cornerstone of American development.[8] On May 6, 1862, after a lively congressional struggle over more than a generation, a free homestead bill received Senate approval following House passage and on May 20, 1862, President Lincoln signed the bill into law.[9]

By this single action, more than by any other, the American wilderness was prepared as a home for free private enterprise and a pathway for civilized endeavor in that part of the New World. The Homestead Act allowed, after January 1, 1863, ". . . any person who is head of a family or who has arrived at the age of twenty-one years, and is a citizen of the United States, or who shall have filed his declaration of intention to become such . . . shall . . . be entitled to enter one quarter-section or a less quantity of unappropriated public lands . . . ".

Because of this far-sighted action the economy of the United States took a great leap forward. Once homesteaders began producing grains and other farm products, American manufacturing invented and fashioned machinery to simplify and expedite the harvesting of crops. An almost incredible growth took place in farm-implement, milling, meat-packing and farm-fencing industries after 1862. Because it had become practically impossible to farm 160 acres profitably by one man, one plough and one animal, mechanization proceeded apace in agriculture. The reaper, twine-binder, threshing machine and, finally, the tractor and truck revolutionized farm life and production. Within 25 years after the Homestead Act became law the United States of America became the greatest producer of agricultural products in the world. Under the provisions of that law more than one and a half million persons in 17 western states were enabled to win title to a total of more than 270 million acres of virtually free land.

Many immigrant "sodbusters" accomplished their initial temporary farm boundary surveys by using a wagon with a cloth tied to a wheel spoke, each revolution of the cloth counting off a definite number of feet. The first great wave of western settlement reached its peak in April, 1889. On the 22nd day of that month some 20,000 land-hungry men arrived at the boundary of Indian Territory. They came on foot, on horseback, in covered wagons and in buggies. At the firing of a signal volley by United States troops the horde of land seekers poured over the line. Before nightfall of that day settlement had taken place on nearly two million acres!

Previous developments of a like nature, though not of such spectacular magnitude, had already ushered in an era of intensive railway construction. In 1853 Congress had passed a measure authorizing the Secretary of War to make surveys for a railway to the Pacific Coast. Army engineers invaded the western wilderness and laid out five routes. The planning and surveying of the right-of-way lasted for several years until the outbreak of the American Civil War. That civil strife erupted before a single spadeful of earth had been turned on actual construction of the transcontinental rail project.

President Lincoln had decided that the line would commence at Omaha and extend to Sacramento. The Union Pacific (working westward) fighting nature's formidable obstacles—and the Central Pacific (working eastward) fighting fierce Indians and outlaws, finally met on May 10, 1869, with a golden spike ceremony at Promontory Point, Utah. By this time most of the free land in the Midwest had been occupied. Between 1860 and 1880 the population of the trans-Mississippi West increased from 9 to 25 million.

Soon after the opening of the century of dynamic American growth the government of the United States had entered other important survey fields. The United States Coast and Geodetic Survey came into existence largely because of the dedicated efforts of Ferdinand R. Hassler (1770-1843). Known then as the Survey of the Coast the agency, formed on February 10, 1807, during President Jefferson's term of office, constituted the first technical bureau of the federal government. During its early career it functioned under various titles but in 1878 was formally christened the Coast and Geodetic Survey. This organization conducts surveys for the making of nautical charts, publishes and distributes the charts, which mainly concern United States coastal waters. It also carries on oceanographic and geophysical investigations and executes geodetic surveys as a foundation for topographic and cadastral surveys, mapping and many engineering works.[10]

But for most of the 19th century the challenge of the land mass of the North American continent north of the Rio Grande took precedence in men's minds. After explorers had probed the West the services of surveyors were enlisted to measure, subdivide and stake out the land, township by township. In both the United States and Canada these surveys were advanced by resort to the contract system, with the work being awarded to qualified surveyors

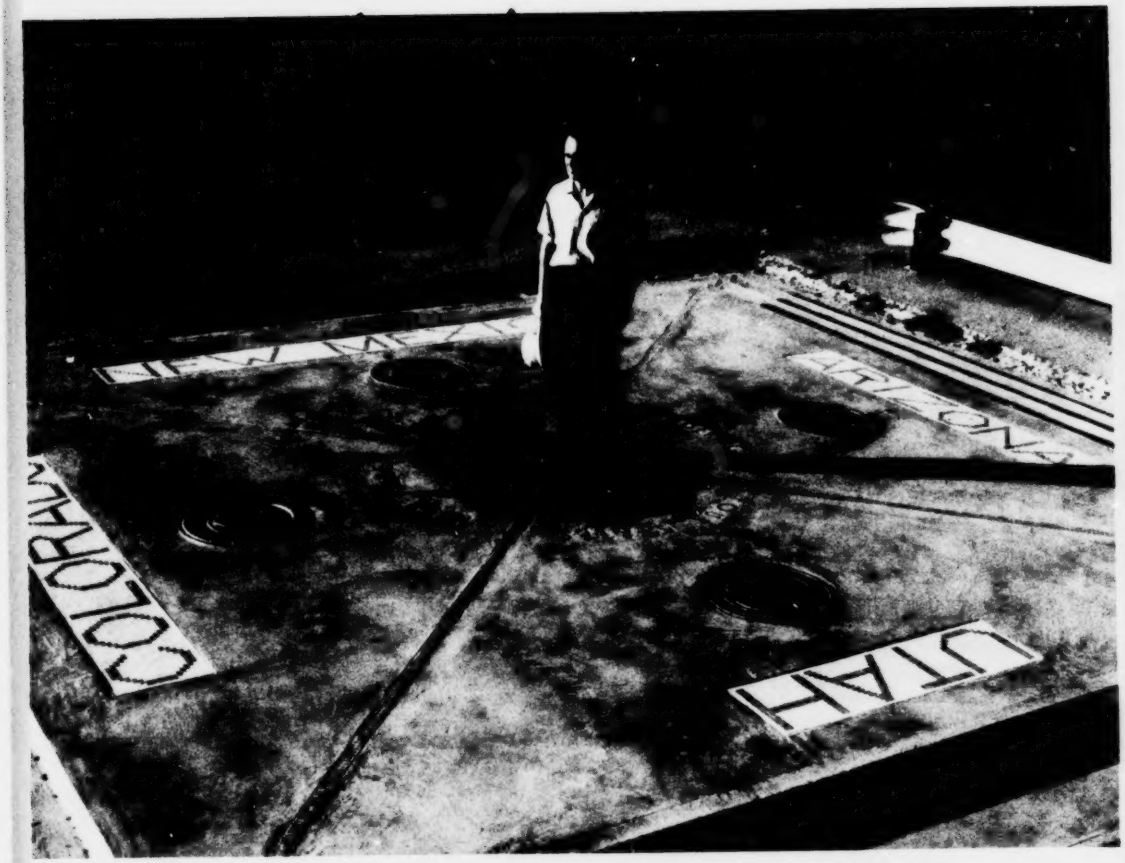

FIGURE 11. A boundary point common to four states, an intersection unique in the United States.

whose bid had been the lowest. In the United States this method prevailed until about 1912 when the federal government developed expert survey crews within its own organization. Surveyors, of course, were required to record detailed field notes covering their professional work and these notes are on file in Washington, D.C., in the keeping of the Interior Department's Bureau of Land Management. The description of almost any parcel of land not included in the original 13 colonies is thus made available for examination or study.

The vast and comprehensive rectangular survey system in the United States provided a simple, reliable, definite and easily understood form of land identification and legal description. This system has extended over a total of more than one billion, 300 million acres of the entire land area of the continental United States. In an amended but largely similar form this system supplied like advantages in connection with the surveying of Canada's western interior.

3

THE DOMINION LANDS SURVEY SYSTEM AND THE WESTERN INTERIOR

"Question surveyors, know our own estate."
King Henry IV (2), Act 1, Sc. 3.

An air traveller's first glimpse of the Canadian prairies in summer is an unforgettable one. Stretching out to far horizons in all directions fertile farmlands can be seen laid out in checkerboard fashion, some squares black with summerfallow, others green with crops, the whole brushed by racing shadows of the occasional cottonpuff clouds so characteristic of western skies. Such is the impressive, memorable spectacle that unfolds across hundreds of miles of landscape, challenging the viewer's imagination and arousing wonderment. That pattern of land division, so reminiscent of the checkerboard, is the visible signature of one of the great civil engineering triumphs of all time. The system of survey of which this panoramic tapestry is a striking by-product, constitutes one of the most outstanding accomplishments of the Canadian government in early post-Confederation years. As an example of a uniform plan of survey over an immense area the project is unsurpassed for precision of execution, permanence of marking and absence of subsequent litigation over property boundaries.

The introduction of the Dominion Lands survey system involved a method of speedily and conveniently identifying any block of farmland governed by it. By a distinctive code any unit of land in the western interior of Canada could be described in a complete and readily understandable form. To those acquainted with the system the code SW¼-28-49-22 W4th, for example, proclaims that the land so labelled is the southwest quarter-section of section 28, township 49, range 22, west of the 4th meridian. In this instance this property is a farm of 160 acres located near the village of New Sarepta, a short distance south and east of the city of Edmonton, Alberta.

But up until the survey season of 1871 the entire western interior, with the exception of

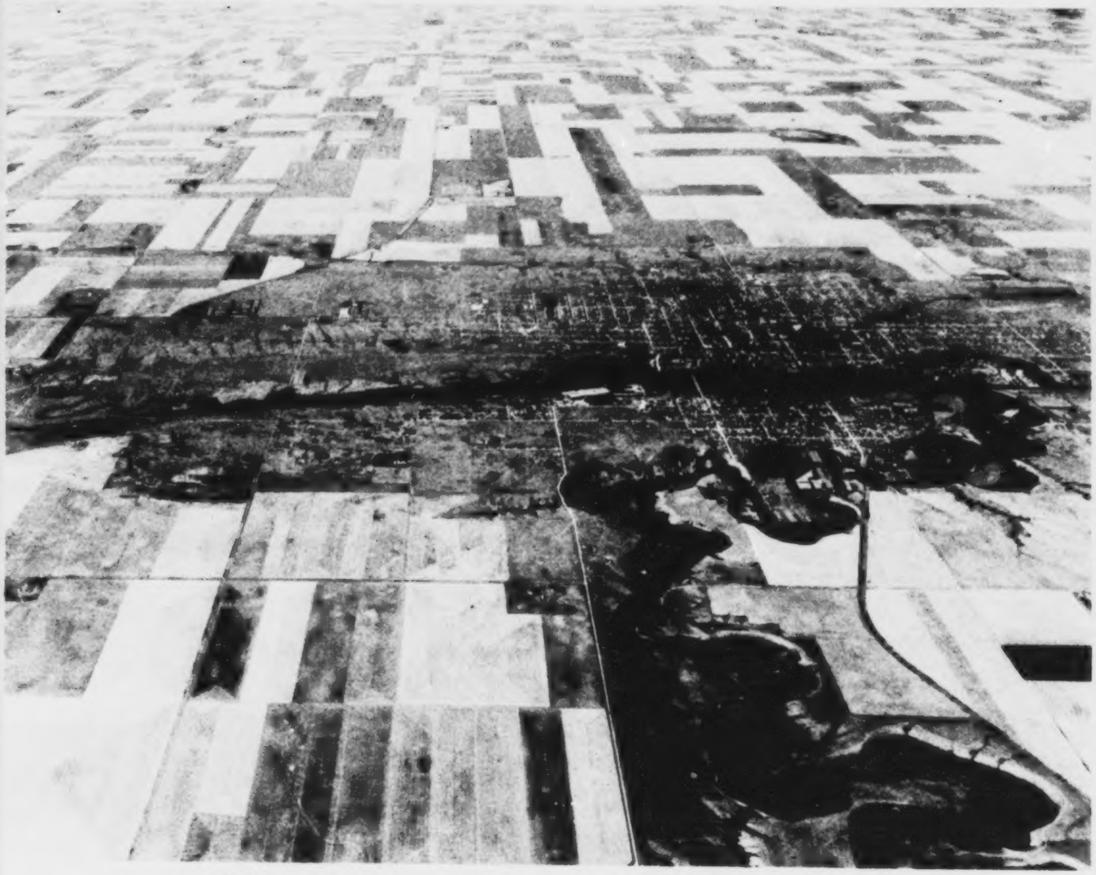

FIGURE 12. Prairie landscape viewed from the air near Moose Jaw, Saskatchewan.

a limited area centred on the Red River Settlement, was devoid of lines resulting from any systematic land surveys. It would seem that the advent in the North West of the first surveyors sent out by Ottawa in 1869 provided the occasion, though not the fundamental cause, of civil unrest in that part of the frontier region. But by autumn of that year these troubles had subsided to a considerable degree. The Manitoba Bill, by which the new province entered Confederation, had been passed following a lively debate in the House of Commons during early May.* On May 3, 1870, the *Globe* (Toronto) reported that the Prime Minister had read to the House a description of Manitoba's boundaries: "The region which is to form the new Province of Manitoba commences at a point on the frontier of the United States Territory: 96° West of Greenwich (passing near Whitemouth) and extends to a point 98°15′ West (passing near Portage la Prairie) being bounded on the south by the 49th parallel of latitude and in the north by latitude 50°30′ ."

The *Globe* reported also that Sir John at this point in his address "placed a map on the House (Clerk's) table showing the boundaries of the new province and members gathered around to examine it." As originally drawn the square-shaped, relatively miniature Manitoba consisting of less than 13,000 square miles, gave rise later to the derisive description, "postage stamp province". But in 1881 the provincial boundaries were altered to embrace over 70,000 square miles and a further extension of its territory in 1912 increased Manitoba's total area to just under 250,000 square miles. In 1871 the population of Manitoba was found to be 25,228 and that of the North West Territories, 73,228. By 1881 both these totals had more than doubled.

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*Section 19 of the measure provided that "the survey . . . of lands in the N.W.T. . . . shall be under the direction and at the expense of the Government of the Dominion."

By mid-summer, 1870, the formal transfer of Rupert's Land to Canada had at long last been accomplished, the new Province of Manitoba created and, by July 15, officially ushered into Confederation. Despite his excesses of conduct Louis Riel was not an annexationist and was, in fact, instrumental in preventing absorption of the North West by the United States during the critical period of métis unrest. Nor did he ever intend to lead a rebellion against the Crown. His principal purpose was to bring about a state of affairs in which free negotiations could take place between the people of Red River Colony and the government of Canada in regard to terms of union. For seven months Riel headed the only effective government in the North West. But now he was in exile and a new vice-regal representative, duly installed, had arrived in Manitoba and entered upon his onerous duties.

Archibald, less knowledgeable than McDougall about the North West, was much more tactful and of a more judicial turn of mind than his former cabinet colleague. But he needed all his natural and acquired skills to deal effectively with problems of civil government arising in the transition period. The native-born people of Manitoba did not relish the sight of immigrants, including some discharged volunteers from the ranks of the Red River expedition, acquiring choice lands in the absence of any satisfactory confirmation of Indian or métis land titles. Staking out property claims, in fact, became a popular mania.

In his written instructions to Dennis a year earlier McDougall had probably influenced the surveyor's approach to the formulation of a workable survey system for the entire West by indicating that "the American system of survey is that which appears best suited to the country except as to the area of the section. The first emigrants [sic] will probably go from Canada and it will therefore be advisable to offer them lots of a size to which they have been accustomed." [This latter phrase is reminiscent of the language employed by Governor-General Haldimand in his 1783 instructions to John Collins.] "This will require you to make the section 800 acres", McDougall observed, "instead of 640 as in the American plan; there should also be an allowance or excess sufficient for public roads."[1]

In making his August 28, 1869 report, Dennis stated that the American system was at fault in making no appropriation for public roads which, under that plan, was taken from the land acquired by the settler. Accordingly Dennis felt that an allowance of acreage for highways ought, rather, to be included within the boundaries of the Canadian form of township. He provided an additional five per cent in each section to ensure that the *net* area of the settler's quarter-section would not be less than 200 acres.

Dennis also came to the conclusion that the 640-acre United States township was unnecessarily small for adoption by Canada. "In a prairie country", he wrote, "where communication facilities are greatly in excess of those in a broken or heavily-wooded country the townships may well be larger, thus tending to economy in the administration of municipal affairs."

The Dennis recommendations concerning the pattern of numbering townships, ranges and sections represent the principal Canadian departure from the then current surveying practice in the United States. Yet this essentially original suggestion drew little or no comment in Ottawa. Townships surveyed in the decade 1860-70 on the north shore of Lake Huron had followed the United States pattern of numbering sections from one in the northeast corner to 36 in the southeast corner. This practice in the States is all the stranger because in the

Northwest Ordinance enacted by Congress in 1785 it was specified that "The Geographer shall designate the townships . . . by numbers progressing from south to north, always beginning each range with No. 1." Dennis would seem to have been more logical and consistent in advocating that not only townships but sections of the township be numbered from south to north, following the anticipated trend of Canadian settlement generally in the West.

Thus Dennis included in his report the recommendation that the "numbering of the townships (be) from one uniform base . . . the southern boundary of the Territory . . . and the numbering of the ranges of Townships east and west from one principal meridian is simple and will be therefore easily understood by all parties." The proposal to award numbers rather than names to new Canadian townships was considered to be the best course to follow as settlers, having in mind the standard practice in the western United States in this connection, would in all likelihood bestow names of their own selection upon these land divisions in the course of time.

McDougall had forwarded the Dennis recommendations to the federal cabinet and on September 23, 1869, these proposals had been formally approved and adopted by the government. Now in January following, a disgruntled McDougall and a somewhat discredited Dennis were back in Ottawa. The arrival of Dennis in the capital had been delayed by an accident he had suffered at Abercrombie en route from the North West and which had resulted in temporary lameness. In the Commons McDougall made a spirited defence of his actions vis-a-vis Red River Settlement but his obvious misconception of the duties vested in him drew sharply critical replies from the treasury benches. Nevertheless he fought hard as a private member for the retention of the 200-acre section in any survey system applied in the new land, firm in his belief that many Americans would be attracted to the Canadian West by a truly liberal land-grant policy.

In the summer of 1870 preliminary instructions were issued from Ottawa to Archibald, over the signature of the Under-Secretary of State for the Provinces, setting forth guidelines on those governmental matters to be advanced at an early date in Manitoba, including the system of surveys. In paragraph 7 of the instructions Archibald was asked "to report as to such lands in the Territories as it may be desirable to open up at once for settlement, transmitting such sketch or plan as may be necessary, with an estimate of the probable cost of survey, a statement of the conditions as to settlement or otherwise suggested for grants of land, such sketch or plan to show the number of Townships it is proposed to lay out at once, their size and situation, and the size of the lots, making the necessary reservation for churches, schools, roads and other public purposes."[2]

It is interesting to note that Archibald was required to include an estimate of the cost of survey. The fact was that as the Canadian government contemplated the establishment of a policy of free homesteads, with little or no revenue accruing to the Crown in the right of the Dominion for some years to come, it was considered essential, at the time, that the cost of surveys in the West be kept as low as possible.

In the West, Archibald's administrative hands were full. He had to attend to the organization of a population census, the appointment of court officers, the meeting of currency requirements, arrangements for collection of customs and excise taxes, meeting with delegations of discontented Indians and to the adoption of measures against a smallpox epidemic, all in addition to his normal daily business. Finally, however, he managed to win time enough to study the pressing needs for a comprehensive western land survey. By December 20, 1870, Archibald's well-considered recommendations were mailed to Ottawa.

In his report Archibald stated, after making introductory reference to the land-grant policy of the Hudson's Bay Company in Red River Settlement, that "the Company has plans of their surveys with a Registry Book referring to these Surveys with numbers of the lots marked thereon consecutively" and observed that "the title of an actual occupant of (such) land depends much on the same kind of evidence as his ownership of a horse or plough."[3]

FIGURE 13
Hon. A. G. Archibald, first Lieutenant-Governor of Manitoba.

As to the proposed new system of federal surveys Archibald wrote, "I take it for granted that the general principle sanctioned . . . September 23, 1869 . . . will be retained. The general principle I take it to be that the land shall be surveyed in rectangular blocks numbered consecutively from one upwards in each Block." But Archibald added that he felt Dennis had not acted judiciously in recommending a deviation from the system of 6-mile (square) townships.

Archibald recited some highlights of American survey history and then observed that in the light of nearly 75 years of practical application of the system without any departure therefrom, "lands of half a continent have been laid out and peopled." In Dakota, for example, their surveys would soon "approach our Boundary all along the line from the Lake of the Woods to the Rocky Mountains . . . the two systems will be coterminous and there are strong reasons for making ours analogous to theirs. The (United States) system is known all over the world to the emigrant classes . . . Why should we change it?"

A lot of 160 acres, he considered, is the "acknowledged extent" of an immigrant's requirements for farm purposes. "In laying out the boundless [sic] prairies to the West of us there might, perhaps, be some justification for liberality in the amount given for a farm lot. But with the limited Territory of Manitoba with Hudson's Bay grants and Hudson's Bay reserves, with squatter's rights and halfbreed rights and Indian reserves our little Territory is already to some extent forestalled, and this does not seem to be the occasion nor Manitoba the province where we should set the first example of prodigality in the allotment of lands . . .".

Then came the most convincing argument Archibald had thus far advanced. "But with 5,250,000 acres to grant and the question before us whether we shall lay it off in lots of 210 or in lots of 160 acres, there is just this difference . . . the system I should recommend would furnish 32,800 homesteads while that of Col. Dennis would give but 25,000 . . .".

"Then as to reasons assigned by Col. Dennis for throwing 10 acres into each lot as an allowance for roads, I cannot consider them sound. Roads required in a neighborhood", Archibald pointed out, "are for the benefit of the body of Settlers. Let those who enjoy the benefit bear the burden and let it not fall exclusively on the man who by accident may happen to be the owner of a lot through which the Road has been made." The United States title, he explained, is without any reservation for this purpose "and yet there is no difficulty among them, and there would be none among us on this point." In this conclusion he was somewhat over-optimistic.

Archibald made brief reference also to the possibility of government land grants in aid of railway building in the North West but this aspect of his recommendations will be considered in a later chapter of this volume.

An important aspect of the Dominion Lands survey system, as it came to be popularly known, was that basic surveys made under it were founded on principles of astronomy. There is mention of this as early as July, 1869, when McDougall gave written instructions to Dennis concerning the inauguration of surveys in the North West, "Mr. Snow will be instructed to assist you, and to place at your disposal any astronomical or other instruments . . . ". Even before 1869 the best surveyors in the Province of Canada were expected to be well qualified in astronomical principles as applied to land-survey work.

Archibald had carried out his assignment concerning western surveys but some member of the federal cabinet, competent in such matters, was required to expedite the transaction of documentary submissions into actions. In Ottawa at this time a new personage appeared in land-survey, policy-making circles. Hon. Alexander Campbell, Postmaster-General, had acquired first-hand experience and a considerable reputation in public lands administration. In Canada West, in addition to being a practising lawyer, Campbell had been Commissioner of Crown Lands from 1864 to 1867. He was now asked by the Prime Minister to formulate a practical, workable federal policy on western surveys, based upon the Archibald proposals.

Serious as were the amendments to his own 1869 recommendations, Dennis must have assented to them in the main. According to his son's account, Dennis submitted a memorandum as early as January, 1871, recommending that "the system of survey be altered, retaining the rectangular principle but making the townships six miles square, with road allowances on all section and township lines of 1.50 chains wide."[4] At any rate on March 1 Governor-General Lord Lisgar transmitted to the Commons a copy of the Order in Council of that date and a memorandum on regulations regarding "Public Lands in Manitoba". These documents enumerated the following salient points relating to survey policy:

"1. The system shall be rectangular.

"2. The Townships shall consist of 36 sections of one mile square each, and road allowances, in all cases 1 chain in width, shall be set out and allowed between all Townships and Sections. Sections shall be numbered thus:

31	32	33	34	35	36
30	29	28	27	26	25
19	20	21	22	23	24
18	17	16	15	14	13
7	8	9	10	11	12
6	5	4	3	2	1

"3. The International boundary shall form the base line for Townships 1 and 2.

"4. The East and West lines between Townships 4 and 5, 8 and 9, 12 and 13, and 16 and 17, shall be base lines or standard parallels in the system.

"5. The meridian line run in the Autumn of 1869 some 90 miles north from the boundary, shown as "Winnipeg Meridian", shall be adopted and continued as the meridian from which the ranges of Townships shall number East and West in the province.

"6. The "jog" resulting from the convergence of meridians shall be allowed and set out as follows:

For Townships 1, 2, 3 and 4 on line between Townships 2 and 3;
For Townships 5, 6, 7 and 8 on line between Townships 6 and 7;
For Townships 9, 10, 11 and 12 on line between Townships 10 and 11;
For Townships 13, 14, 15 and 16 on line between Townships 14 and 15.

"7. In the survey of any and every Township the deficiency or surplus, as the case may be, resulting from the convergence of meridians, shall be set out and allowed in the quarter sections on the west boundary—the area of which shall in the survey be returned accordingly at their actual contents."[5]

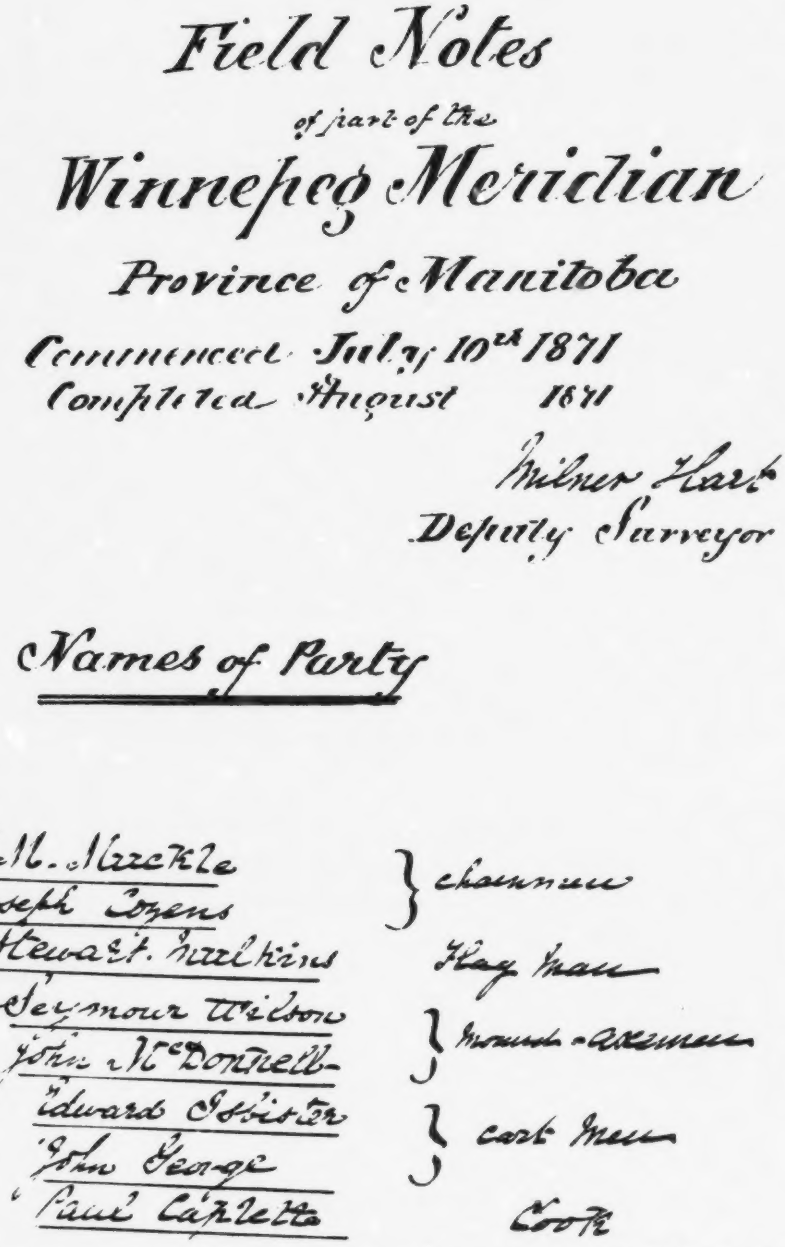
It is passing strange that if Dennis in January recommended that western road allowances be made 1½ chains (99 feet) wide, government proposals reaching the Commons in March should provide for such roads to be 1 chain (66 feet) wide. It was unprecedented in Canadian surveying practice to have road allowances 99 feet wide. In very early times roads in Central Canada had been made 40 feet wide but the more modern roads, by 1870, had all been made 66 feet, without exception.

Considerable asperity was displayed in the Commons debate on the government's proposals, especially on the reduction of the size of sections to 640 acres. On April 6, 1871, McDougall moved a set of eight resolutions in the Commons, the first three of which related to surveys. In these three propositions he complained that (1) the subdivision of townships in the North-West Territory had been materially altered to the disadvantage of intending settlers; (2) the area of townships had been reduced to six miles square and each quarter-section or lot reduced from 200 acres to 160 acres and (3) the allowance for roads . . . had been limited to one chain in width and ordered to be set out and allowed between all townships and sections . . . "without any reference to their utility or convenience."

McDougall concluded this presentation with a resolution "to provide for the issue of amended regulations for the survey, distribution, settlement and sale of lands in Manitoba . . .".

The answer from the government side in regard to road allowances was that the plan recommended to Parliament had worked most admirably in Quebec and Ontario and though not in force in the United States, many American surveyors had expressed approval of it and the government thought they could not do better than adopt a system that had proved so acceptable. Manitoba's Dr. Schultz intervened in the debate to assert his belief that the plan of survey submitted to Parliament for his home province was superior to that of Ontario. He thought that in view of the smallness of the province the lots (quarter-sections) should be small also. He gave cogent reasons in support of the proposition that roads ought to be 1½ chains wide. Existing roads in Manitoba, he pointed out, were 2 chains wide. He praised the durability of unpaved prairie roads but failed to suggest that one very good reason for making roads reasonably wide in that region was that when such roads became heavy from rains or melting snow, it was desirable for Red River carts to leave already deep ruts to shift to firmer surface. Also wide roads would make it easier for carts to make a complete turn-around. Summing up, Schultz stated his firm belief that it would please the whole of Manitoba if roads were made 1½ chains wide.

On April 13 McDougall withdrew his proposal for new regulations as, he said, the



Field Notes

of part of the

Winnepeg Meridian

Province of Manitoba

Commenced July 10th 1871

Completed August 1871

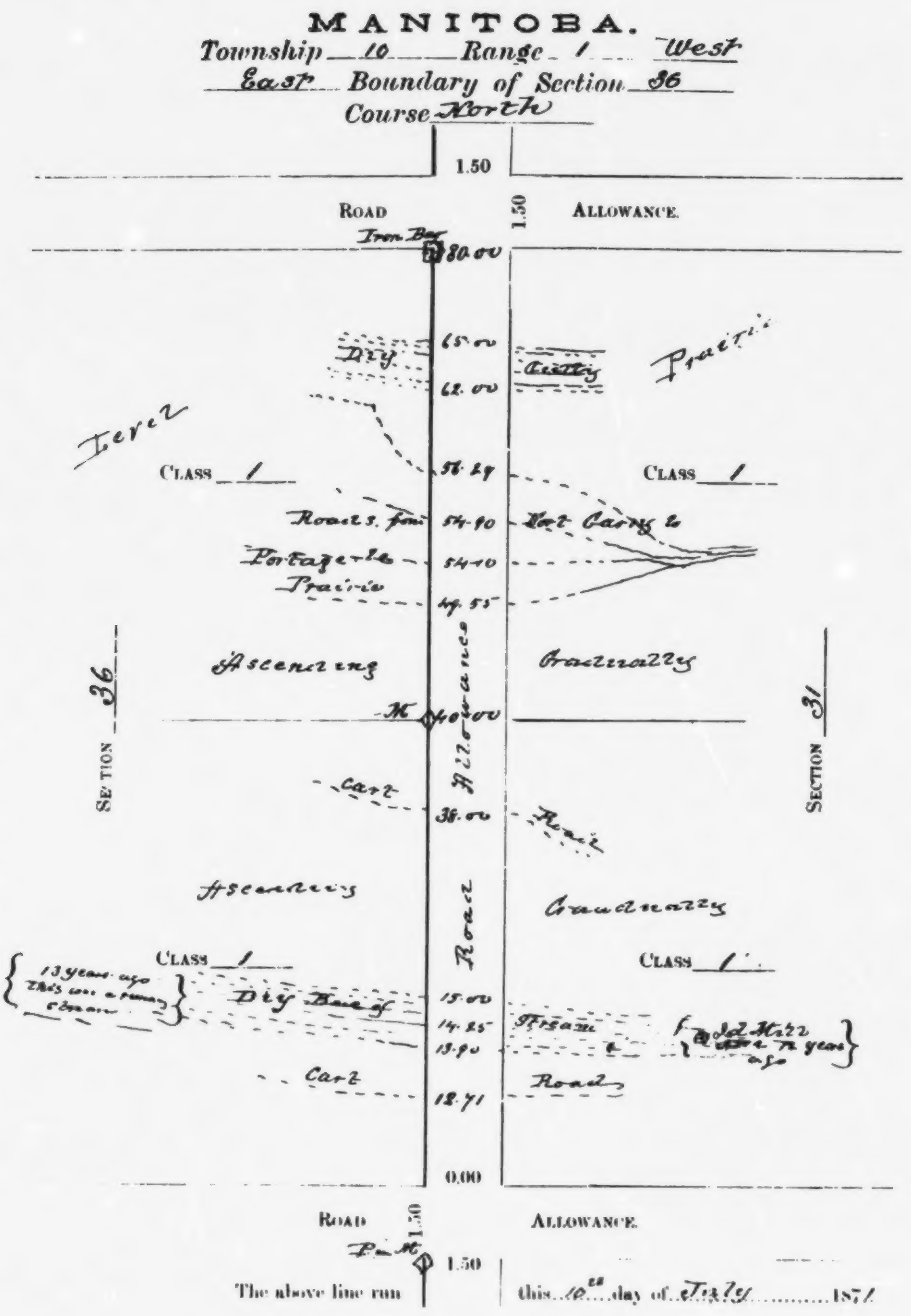
Milner Hart

Deputy Surveyor

Names of Party

A. M. Nickle	chainmen
Joseph Cozens	
Stewart Hawkins	Flag man
Seymour Wilson	mound-axemen
John McDonnell	
Edward Isbister	cart men
John George	
Paul Caplette	Cook

FIGURE 14. Title page and names of 1871 survey party, from Milner Hart's field book. This book contains notes of the first mile run on Dominion Lands Surveys.


MANITOBA.

Township 10 *Range* 1 West

East *Boundary of Section* 36

Course North

1.50
ROAD
1.50
ALLOWANCE.
Iron Bar
80.00
65.00
Dry
Gully
62.00
Prairie
Level
CLASS 1
56.27
CLASS 1
Roads from
54.90
Fort Garry to
Portage la
54.10
Prairie
49.55
Ascending
Gradually
SECTION 36
M
40.00
Allowance
SECTION 31
Cart
38.00
Road
Road
Ascending
Gradually
CLASS 1
CLASS 1
13 years ago this was a running stream
Dry Bed of
15.00
14.25
Stream
13.90
Old Hut built 11 years ago
Cart
18.71
Road
0.00
ROAD
1.50
ALLOWANCE.
P. M.
1.50

The above line run this 10th day of July 1871

FIGURE 15. Sample page, Milner Hart's field book, 1871.

government had expressed readiness to adopt "the most important of them". Thus on April 25, 1871, for the First System of Survey, so-called, road allowances were increased to 1½ chains or 99 feet.

In regard to the distribution under Section 31 of the Manitoba Act of 1,400,000 acres appropriated for the benefit of the families of half-breeds, it was also provided that every half-breed resident of Manitoba at the time of transfer thereof to Canada (July 15, 1870) and every child of such resident, "shall be entitled" to participate in the acreage thus made available.

Events of considerable magnitude followed swiftly. On March 7 Dennis by Order in Council was made Surveyor General of Dominion Lands and at the same time appointed head of the newly-formed Dominion Lands Branch of the Department of the Secretary of State. On April 12, exactly 112 years after the battle of the Plains of Abraham, the Commons approved the government's submission concerning western survey policy and voted $100,000 to finance the prosecution of such surveys. On April 25 an Order in Council was passed, replacing the March document and making road allowances 1½ chains wide. Early in July of 1871 a staff of 13 survey parties was organized by Lindsay A. Russell, first assistant to the Surveyor General. These took the field in Manitoba, six parties to the settled parts and seven to the virgin lands. On May 1 a Manual of Surveys was issued by the Surveyor General, the first of a series of such manuals. These publications explained the Dominion Lands Survey System to deputy surveyors, as they were then known.

An aura of mystery and conjecture has, to some extent, surrounded the placing of the Winnipeg Meridian, ever since it was surveyed and marked on the ground. A meridian line is the trace of a plane passing through any given point on the earth's surface and through the two poles of the earth's axis as well. The records indicate that astronomical observations were taken at Pembina to determine the exact location of the international boundary in that vicinity. Thereupon the initial or starting point for the Principal Meridian was fixed 10 miles to the west on that boundary. The relationship of the Principal Meridian to the prime meridian passing through Greenwich, England, is expressed by the longitude description of the former line. This has been reliably ascertained to be 97°27′28″.41 West longitude.

Why then, it may be asked, was not this Principal Meridian not run at 98° West longitude? To have done this would have been more in keeping with the pattern of other initial meridians subsequently laid down and tied in with the Dominion Lands Survey System. Each was placed exactly 4 degrees apart, commencing at 102° West longitude, the location of the 2nd Initial Meridian. Astronomical observations were taken at Pembina in 1869 to determine the position of the international boundary after which the initial point of the Principal Meridian was fixed as already indicated. But why ten miles west of Pembina? All available evidence indicates that this particular point was selected in order to avoid the then settled, cultivated areas as well as a belt of timber spreading along the Red River. The point could not be fixed as far west of the river, however, as to be inconvenient for dependent surveys proposed for the vicinity of Fort Garry. It is also possible that, in the absence of any reliable map of the area, it was considered that the 10-mile margin would allow ample clearance of settled river properties as well as the wooded areas.

The Principal Meridian supplied the main backbone of the Dominion Lands Survey System. The Second, Third, Fourth, Fifth and Sixth Initial Meridians, west of the Principal Meridian, all marked on the ground, were lines only slightly less vital to the successful application of the entire western Canadian survey structure. As part of a special survey of meridians and base lines in the North West in the season of 1874 the position of the Principal Meridian was checked for accuracy in the field under the supervision of L. A. Russell. His report on that work is of particular interest.[6] He commences by making references to his survey work two years previously: "for the purposes of the British section of the International Boundary and those of the D.L.S. in 1872 Captain Anderson, R.E., Chief Astronomer of the British Commission at Pembina, in cooperation with myself at Chicago—determined by the electro-telegraphic method the difference of longitudes between the observatory at Chicago and his astronomic station (at Pembina). This, with the known relative positions of Chicago and Greenwich will give, by reference to the Pembina station, the necessary connection of all future surveys with Greenwich.

"Hence the adoption of the astronomic station on the 49th parallel at Pembina as the point of departure for the present survey.

"The accuracy of position, relatively to the 49th Parallel, of our bases can always be checked by carefully observed astronomical latitudes, therefore the actual measurement on meridians, northing and southing, does not require to be made with as minute precision as that along the bases in the east and west direction, on which no direct astronomic observation gives a check of any value.

"Until telegraph lines are constructed throughout the country traversed, the accuracy of differences in longitude will depend solely on that of survey measurement.

"For this reason it was necessary to employ the method of triangulation in carrying the survey westward. On the check survey of the Winnipeg Meridian careful double chaining was deemed sufficient. The interval of ten miles between the meridian and Pembina station was not triangulated, the circumstances being so favourable to accurate chaining, and the distance so short, that thrice measurement by that means was considered sufficiently accurate . . .

"I have reason to believe, from the close inter-agreement of the different measures of each mile, that the longitude of the Winnipeg Meridian from the Pembina astronomic station is determined to a couple of feet, or as closely as measurement with the ordinary chain will admit. The evenness of ground—perfectly level prairie—was in the utmost degree favourable to accuracy."

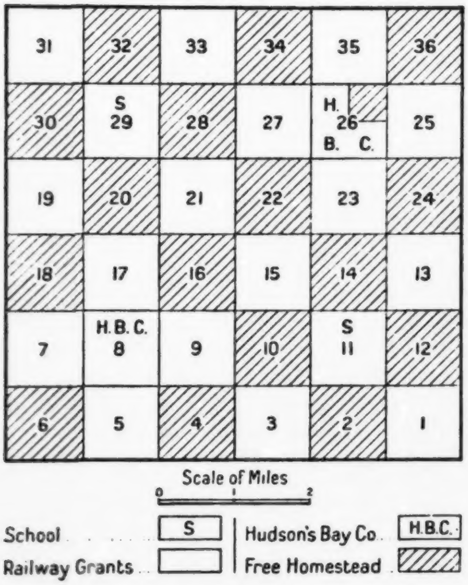


FIGURE 16. Diagram of a typical township in Canada's western interior.

Within a period of six years meridians and base lines had been established from Winnipeg to the Rocky Mountains and from the international boundary to the North Saskatchewan River, making possible the rapid and orderly expansion of regular surveys in the early 1880s and the resulting influx of settlers. This survey system is in marked contrast to the 35 principal meridians laid down in the United States, most of which lines extend over relatively short distances, are arbitrarily located and not in any way inter-connected or inter-related. In its newly-acquired territory Canada could apply "one vast system of survey uniform over the whole of it."[7]

The policy adopted in Canada of numbering sections from No. 1 in the southeast corner of a township upwards in criss-cross fashion to No. 36 in the northeast corner, was wisely adapted to the natural trend of settlement in the Canadian West. It will be recalled that Dennis in his 1869 recommendations provided that, as in the case of sections, the "numbering of the Townships (be) from one uniform base . . . the southern boundary of the Territory . . . and the numbering of ranges of Townships east and west from one principal meridian is simple and will be therefore easily understood by all parties." With his second paragraph of the 1870 recommendations Archibald included a diagram setting forth the now firmly established Canadian system of numbering consecutively ***from one upwards*** in each Block.

It is curious that the American and Canadian systems should differ in this matter of numbering land parcels. One great advantage deriving from the 1785 Ordinance (United States) was that the system thus introduced brought numerical simplicity, a result made possible by the uniform grid concept. Townships were to be designated "by numbers progressively from south to north, always beginning each range with number one". The ranges or north-south columns of townships were to be distinguished "by their progressive numbers to the westward." No mention, however, was made of any method of numbering sections.

Square-mile lots within townships were to be "numbered from 1 to 36, always beginning the succeeding range of the lots with the number next to that which the preceding one concluded." Under this rule the numbering could begin in any corner of a township.[8] Eleven years later the Land Act of 1796 failed also to give guidance on the proper method of numbering. Jared Mansfield, successor to Surveyor General Putnam, progressively numbered his ranges of townships eastward and westward from the meridian and the townships between each range, northward and southward from the base line.

Oddly, however, the 1796 Act specified a definite order for numbering sections within townships, "beginning with number one in the northeast section and proceeding west and east alternately . . . ". The Act merely indicated an expectation that townships would be identified by numbers.

All types of unforeseen difficulties hampered surveys in Manitoba during the 1871 season and slowed down the pace of the work. Forest fires were serious enough to cause frustrating delays. In several instances the equipment of entire parties was burned out completely. Fenian raids from across the international boundary also proved to be an interrupting factor. Lindsay A. Russell wrote to Surveyor General Dennis from Fort Garry on September 21, 1871: "With respect of the settlement surveys I find their progress discouragingly slow and yet cannot find fault as the surveyors seem to be doing their best . . . Nearly all the settlement surveys are hindered more or less by the woods. Indeed, in some cases I authorize the temporary employment of an extra man or two for a few days to get faster through a thick place, the allowance of one axeman and two chainmen being rather unprofitable in dense woods or thick shrubbery . . .

"For some cause, I know not, men seem to be continually leaving the surveyors. There is always one or other of them complaining that a man has left him and he has to look for another . . .

"With reference to Mr. Sinclair's survey I am sorry to say that it is again arrested in its progress through his having disagreed somehow with the surveyor [Mr. Grant] who has been conducting it for Mr. Sinclair. The latter is, I fear, likely to be unwell all autumn and though it pains me to do it, I shall be obliged to hand the survey over to someone else—or it will not be done in time to be united with the other surveys in the general plan of the settlement . . .

"Nearly all contract surveyors are complaining of the unexpectedly large proportion of wood on their lines and, of course, all bidding for the chance to get a township with much prairie. Some three or four of the sub-division contracts will be completed in a couple of weeks when I will, in accordance with my instructions and with the Lieut.-Governor's advice as to locality, give out some more to those of the surveyors whose work has been performed in a satisfactory manner . . . ".

Again, on October 6, 1871, from St. James, Russell wrote to Dennis, "Now we have the excitement and interruption . . . with respect to the Fenians. The Government Proclamation calling all to enrol themselves has necessarily arrested our surveys as many of the men were old volunteers. While I write [this] Mr. Doupe* has come in to say that the offer of all our services is accepted and that this afternoon the news of the Fenian advance across the [boundary] line has led to an immediate call to arms for the whole of us."

Practical experience gained in three field seasons, following the resumption of federal land surveys in the North West in 1871, led to the adoption of what has since become known as the Special Survey. Despite all efforts to make the basic surveys, as authorized in 1871, as accurate as possible, errors crept into the system from time to time. Accordingly some new measure had to be devised to supplement and to correct the general survey. Surveyor General Dennis, in drafting the first Dominion Lands Act, expected that discrepancies of the general survey could be kept within narrow limits and that is where he was wrong. As time went on discrepancies sometimes exceeded one-quarter of a mile when, according to the surveyors' field notes everything was perfect. In the extension of surveys west of Manitoba similar discrepancies, but on a smaller scale, occurred.[9] In passing judgment on such imperfections it is only fair to take into consideration the fundamental purpose of the Dominion Lands Survey System. A high degree of accuracy was not as important as the need to have measured land available to settlers on an orderly, workable basis of allotment. Urgency of performance was the order of the day. Account should be taken also of the types of surveying instruments as well as techniques developed up to that time. Nor was the survey system for the region intended primarily as a reliable basis for topographic mapping. Inspection facilities were also overstrained in those pioneer days.

To deal with the condition that had arisen, the Special Survey was instituted by Order in Council passed in February, 1874. By this step more refined and more scientific procedures and equipment were introduced. In part, these improvements were made for the purpose of checking on survey work already completed. But there were larger purposes to be served as well.[10] The Special Survey was designed to establish a practical basis for the extension of township surveys at any point along the proposed Canadian Pacific Railway route and thus contribute to the systematic settlement of the West. Secondly, the Special Survey was devised to assist in railway construction by facilitating locations of land grants along the line. In addition it would provide a reliable fund of information on the natural resources of the region, its soil and timber types, minerals as well as its flora and fauna.

The establishment of meridians and base lines, to be performed by a separate party under the supervision of the chief of the Special Survey, was to be checked periodically by means of astronomic stations set up for the purpose and by a continuous triangulation. This net of surveys was to be extended northward from the 49th parallel of latitude to the Peace River and Lake Athabasca. Errors in the original surveys west of Manitoba were to be located and corrected by astronomic observations. As Deville put it, "measuring on the earth by means of stars is a roundabout way of finding distances, and not a very accurate one but it was the best we could do. We thus managed to keep errors within bounds inside Manitoba".

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*Joseph Doupe, D.L.S., father of Jacob Lonsdale Doupe, D.L.S.

Lindsay A. Russell (1839-1912), at the time Assistant Surveyor General for Canada, was appointed to direct this important special project.[11] He was the son of A. J. Russell, C.E., and had been an efficient assistant in charge of construction of the Dawson Route when it was being prepared for use by the Red River expedition of 1870. On July 26, 1871, Lindsay Russell was appointed Inspector of Surveys in the field and in February of the following year became Assistant Surveyor General. From that time forward, until the 1880s, he was in full charge of survey work in the field while the time and energies of his chief, John S. Dennis, were fully occupied by administrative duties in Ottawa.

FIGURE 17
Lindsay A. Russell, Surveyor General of Canada, 1878-1884.

In any serious study of Special Survey records it is necessary to distinguish constantly between two highly competent surveyors, L. A. Russell and A. L. Russell. Alexander Lord Russell, D.L.S.* was first assistant to Lindsay A. Russell in the Special Survey. He was from Port Arthur, Ontario, was not, as far as is known, a relative of the Assistant Surveyor General. He was the son of Andrew Russell (1804-88) who, as a civil servant, performed a significant administrative role during the formative stages of land survey work in what is now Ontario and also in Canada's western interior. A. M. Burgess, Deputy Minister of the Interior, in his 1885 report to the Minister of that department, paid a resounding tribute to Andrew Russell of the "inside [civil] service at Ottawa" who had held the post of Chief Clerk of the (Land) Patenting Branch, Department of the Interior, since its creation. After referring to Andrew Russell's 80 years of fruitful life, including more than half a century of faithful and efficient public service, Burgess pointed out that he had been "for the greater part of his long period of service Assistant Commissioner for Crown Lands in the old Province of Canada [prior to Confederation] . . . [and] that to him perhaps more than to any other man, living or dead, we owe the perfection which has been attained in our system of public lands surveys."

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*Surveyors of Dominion Lands appointed under the Dominion Lands Act, 1872 (such appointments made effective as from April 14, 1872) were admitted to practise as "Deputy Surveyors of Dominion Lands" but, by 1873 all were styled "Dominion Land Surveyors" (D.L.S.).

A year earlier, on March 20, 1884, Otto J. Klotz (1852-1923), D.L.S., D.T.S., had been equally laudatory. An address to Andrew Russell was drawn up bearing that date, written on behalf of all Canadian surveyors. It was signed by Klotz as president of the Association of Dominion Land Surveyors. In part the address declared, "It was you who introduced into Canada the use of the transit theodolite upon public surveys, displacing the less accurate and variable compass. It was you who pointed to the stars for a sure guide, instead of the fickle magnetic pole." But if Andrew Russell had much to do with the degree of accuracy developed in land surveys in Ontario and the new West, Lindsay Russell's skill, knowledge and wise direction served to lay solid foundations for the notable combination of speed and perfection attained under the Dominion Lands Survey System.[12]

Triangulation between the Principal and Second Meridians was completed in 1875 during the Special Survey. Lindsay Russell in his report of the season's accomplishments stated that "the greater part of next season's work will be in a country more thickly wooded than any yet passed through. On this account and (because) newly constructed telegraph lines afford facilities for frequent checking the differences of longitude it would be advisable to change the method hereto pursued, and, dispensing with triangulation, confine the active measurements in the field to surveying carefully in the ordinary manner the parallels and meridians that are to serve as a basis for the extension of any point desired of the block outline system. This would reduce materially the expenditure for the survey. A further economy may be effected by doing away with the levelling party which will, for some time, be unnecessary because from Fort Pelly to near Fort Edmonton the special survey will be in the vicinity of that of the Canada Pacific Railway. It would be an unprofitable repetition to level over country of which its engineers have in their locations of their line, already obtained

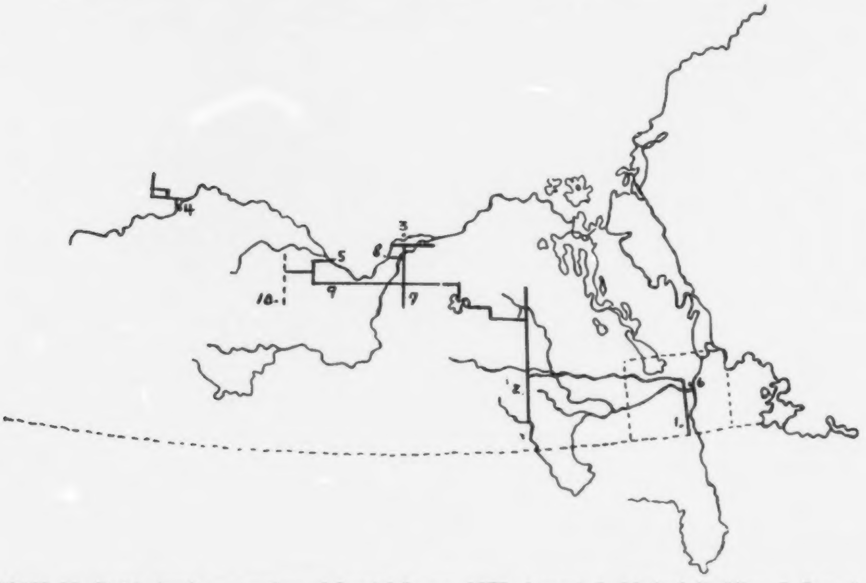
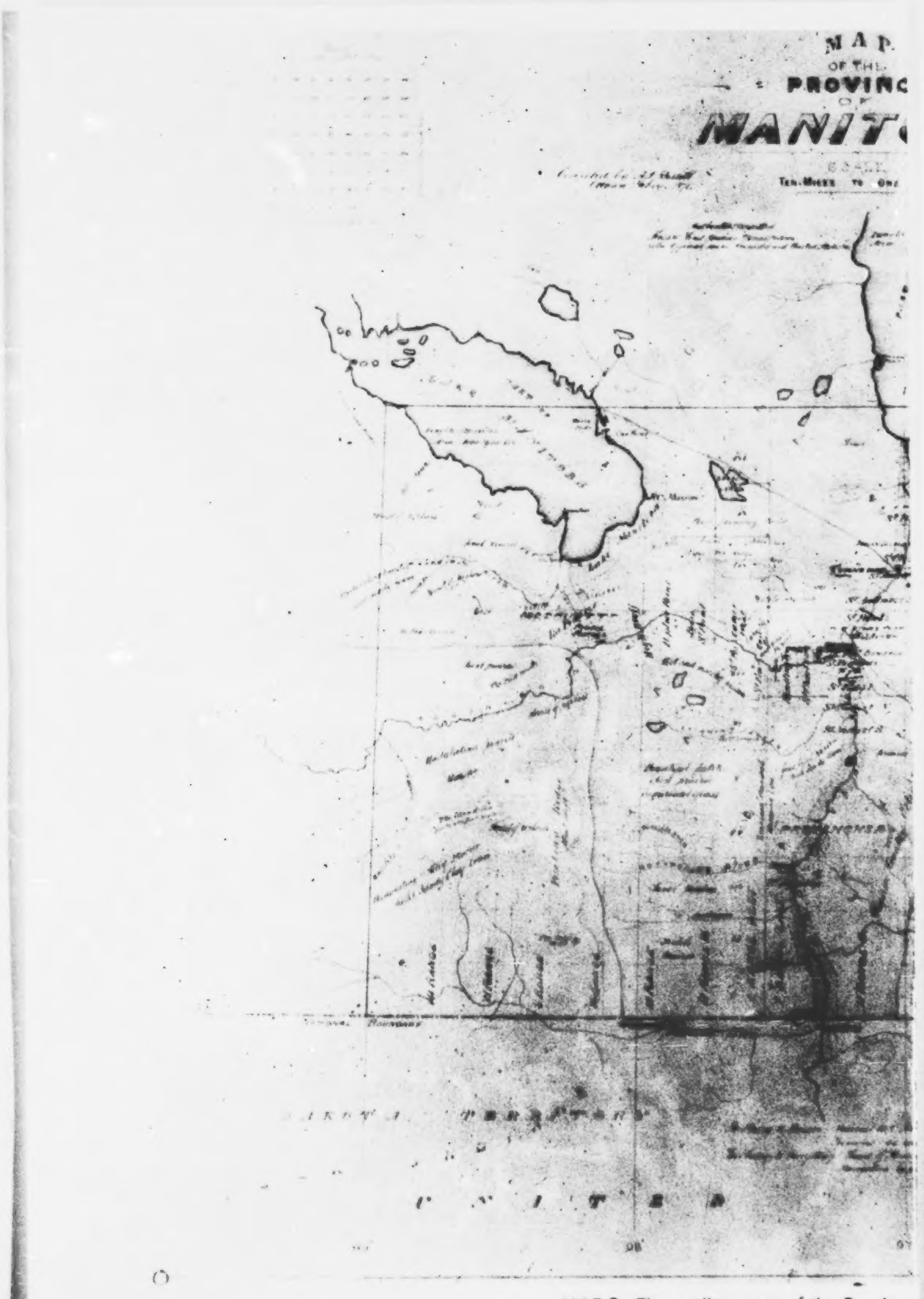


FIGURE 18. Sketch showing operations of Special Survey, 1878. Legend: 1. Principal Meridian. 2. Second Meridian. 3. Prince Albert. 4. Edmonton. 5. Battleford. 6. Winnipeg. 7. Third Meridian. 8. Carlton. 9. Tenth Base Line. 10. Fourth Meridian.


MAP
OF THE
PROVINC
OF
MANIT
SCALE
TEN MILES TO ONE
AKOTA TERRITORY
U N I T E D
98
97

MAP 3. The earliest map of the Province

BA
T A T E S
49°
96°
95°

Manitoba, drawn by A.L. Russell, 1871.

profiles."[13] Incidentally, H. B. Smith, C.E., a leveller, had been employed by A. L. Russell in the preparation of profiles along the lines surveyed under the Special Survey.

An improved base measuring apparatus was designed by Lindsay Russell for use on the Special Survey. He visited England in the autumn of 1873 to supervise construction of the instrument. To meet the exacting technical requirements of the project it was necessary to devise an instrument, readily portable, yet sufficiently accurate to fill a pressing requirement between the rather rough measurements of the ordinary chain on the one hand, and on the other, the relatively complicated and cumbersome base-measuring apparatus then commonly employed on primary triangulation work. In practice this new instrument proved fairly equal to the demands made upon it. It was well adapted to rapidity of use and gave results sufficiently accurate for triangulation of a second order. Its employment in the field in the West demonstrated that one mile a day could be measured over reasonably level country with a remarkable degree of accuracy.

Lindsay Russell's keen concern over the costs of the Special Survey was not altogether surprising. Depressed economic conditions were widespread in the world of the 1870s and Canada was not then a wealthy nation. As the North West was to be opened up on the basis of Free Homesteads, with little or no revenue accruing to the Dominion for years to come, it was important for the government to keep survey costs to a minimum. Under the circumstances the Special Survey proved to be an undertaking rather too expensive for the federal treasury to bear and the project had to be abandoned. In all, the Special Survey extended over the span of six consecutive seasons. It was prosecuted as far as the Fifth Meridian by Lindsay Russell and his staff with the utmost care and precision. Set-backs and discouragements were numerous. Excess water on the plains from rapid spring thaws and lack of feed for horses early in the season were some of the hazards encountered. When Lindsay Russell met with an accident in the field in Manitoba in June, 1875, fracturing his ankle, progress of the Special Survey was hindered. Hon. David Laird, Minister of the Interior, had occasion to make official reference to this painful mishap and expressed regret that "the surveying party was deprived of the active cooperation and personal supervision of its able and energetic chief officer."[14] Nevertheless fair headway was made in that season under the first assistant, A. L. Russell.

The permanent value of the Special Survey cannot be easily over-estimated. The project made possible the rapid expansion of the general survey when time was of the essence, as well as the astonishing coverage by surveyors during the peak year of prairie surveys, 1883. Much of the credit for the high standard of excellence achieved by and under the Dominion Lands Survey System is due to those who conceived the Special Survey and to those who carried that concept into effect. In this manner Canada avoided extensive litigation and a variety of other troubles experienced in the United States as a result of settlers staking out property in advance of the official survey.

From 1871 to 1878, with the exception of only two seasons, there were, on the average, only a score of land surveyors employed on Dominion Lands survey work in the western interior of the nation. But in 1879 the numbers rose to 32, heralding a series of impressive annual increases in numbers until 1883 when a peak of 115 was reached, 21 on township outlines, 82 on subdivisions along with one Settlement Belt surveyor and one town-plot surveyor. In addition there were four examiners of contract surveys who were busy in the field. This period of expanded survey activity coincided with Sir John A. Macdonald's term as Minister of the Interior while also serving as Prime Minister. Sir John was succeeded in the Interior portfolio by Hon. David L. Macpherson, who remained only two years in that position. In 1884 there was a pronounced drop in the number of land surveyors employed in the West, to 71, and an even sharper decline to 13 in the troubled, fateful year, 1885.

FIGURE 19. Surveyors encamped near the North Saskatchewan River in the 1880's. Note the Red River carts in the background.

John S. Dennis Jr., in his history of surveys under the Dominion Lands Survey System (1869-89) describes the 1883 surveys as having been conducted on "a gigantic scale". It is a fact that the exceptionally large number of surveyors in the field, along with assistants, laborers, teamsters and cooks constituted for those early days an impressive array of men, horses, carts and buckboards. A corps of mail carriers visited various parties in the field, transmitting ordinary mail as well as special despatches to and from survey headquarters. But why should there have been such intensive surveying activity at this stage of Canada's development? Probably the most important factor was the surprisingly rapid construction westward of the Canadian Pacific Railway main line that season. Steel reached the Rocky Mountains in the autumn of 1883.

A noted Surveyor General of Canada, nearly 30 years later, in addressing a gathering of fellow surveyors in Ottawa, shed light on the survey program decisions of the 1883 season.[15] Edouard G. D. Deville, D.L.S., D.T.S.,* in that year had become Chief Inspector of Surveys at Ottawa while William F. King, D.L.S., D.T.S., was made Inspector of Surveys in the field with his office at Medicine Hat. "The C.P.R. . . . wanted to make [the] surveys themselves; they wanted that [western] task transferred to them . . . They went to the Minister and explained to him that it would be impossible for the Department of the Interior to survey such an amount of land as (was) in their [railway] grant . . . 20 million acres! It was quite impossible . . . Well, I induced our Minister", Deville recalled, "to try us anyway and to give us a chance . . . [Sir John A. Macdonald was Minister then]. Well, the chance

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*Dominion Topographical Surveyor, a title of special distinction bestowed on Canadian surveyors who have proved their knowledge of higher surveying theory and practice.

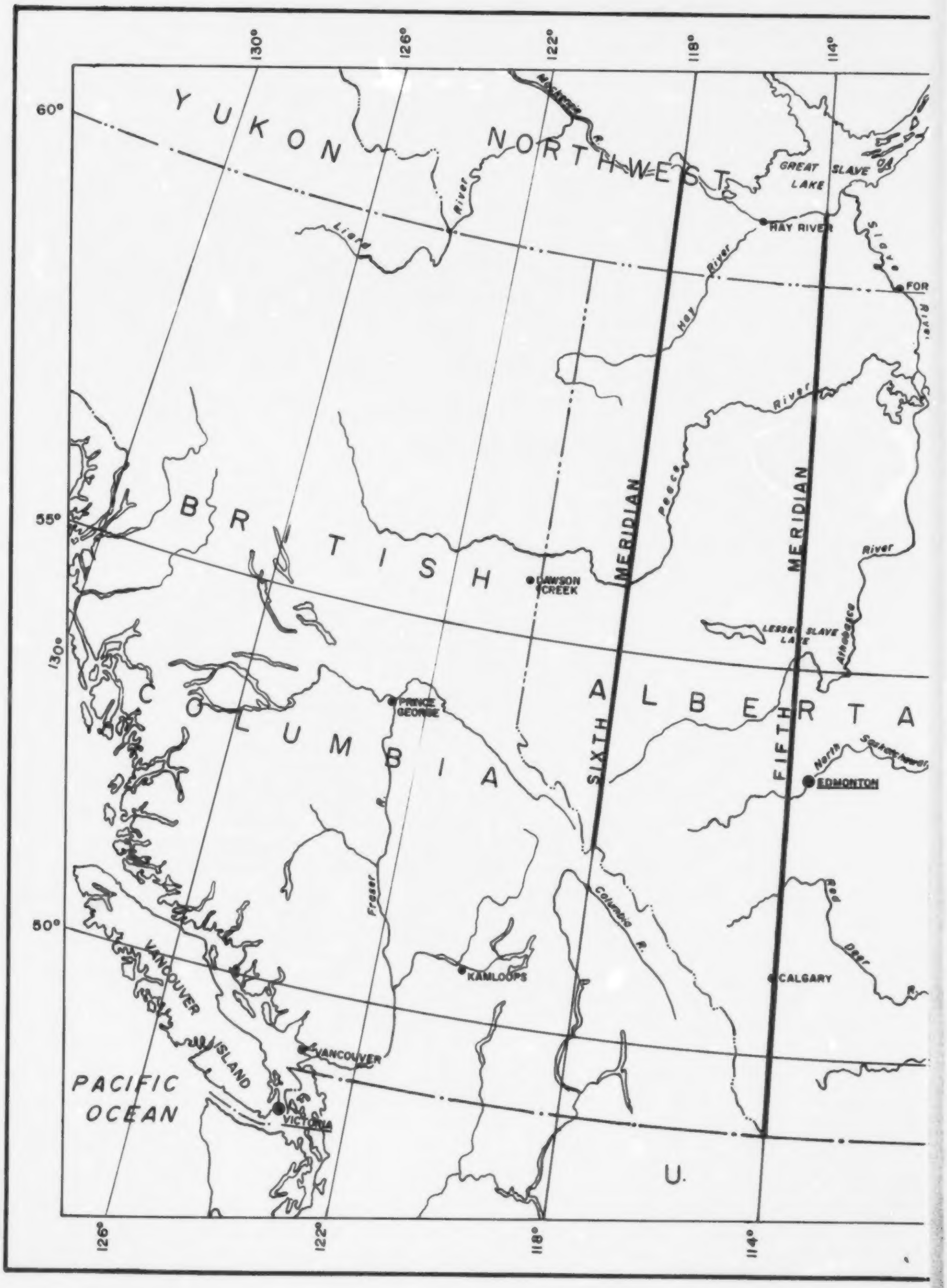
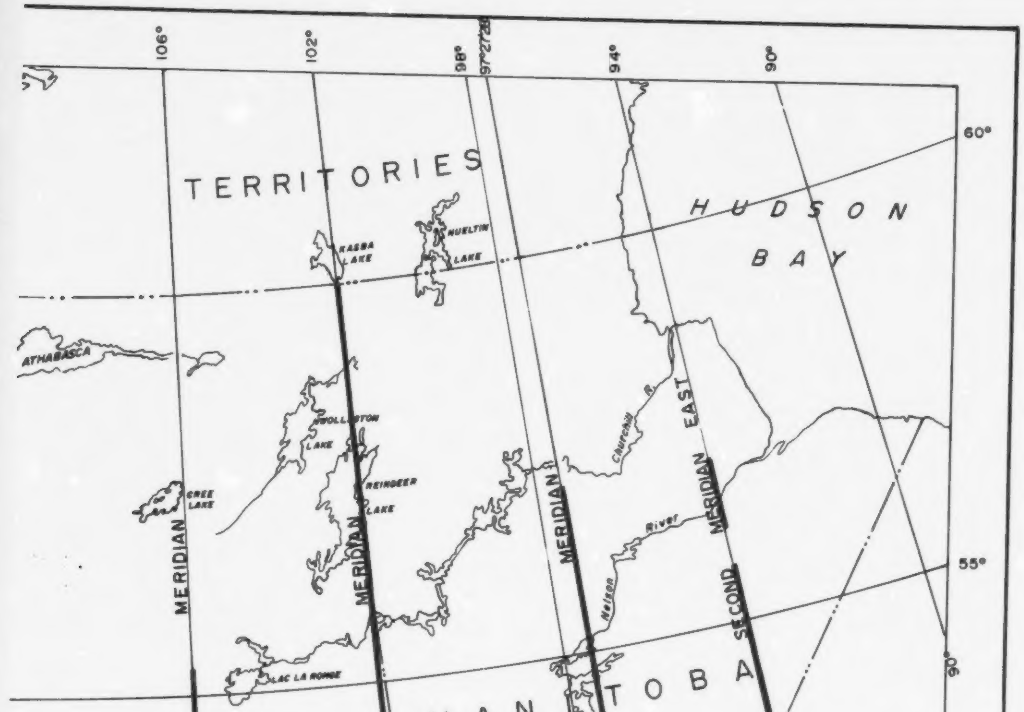

130°
126°
122°
118°
114°
60°
55°
50°
130°
126°
122°
118°
114°
YUKON
NORTHWEST
GREAT SLAVE LAKE
HAY RIVER
FOR
Liard
River
Mackenzie R.
Hay River
Slave
River
Peace River
Athabasca River
BRITISH COLUMBIA
ALBERTA
SIXTH MERIDIAN
FIFTH MERIDIAN
DAWSON CREEK
LESSER SLAVE LAKE
PRINCE GEORGE
EDMONTON
North Saskatchewan
Fraser R.
Columbia R.
Red Deer R.
CALGARY
KAMLOOPS
VANCOUVER
VICTORIA
VANCOUVER ISLAND
PACIFIC OCEAN
U.

FIGURE 20. Prime meridi


106°
102°
98°
97°27'28"
94°
90°
60°
55°
50°
TERRITORIES
HUDSON BAY
KASBA LAKE
NUELTIN LAKE
ATHABASCA
WOLLASTON LAKE
REINDEER LAKE
CREE LAKE
Churchill R.
River
Nelson
LAC LA RONGE
THIRD MERIDIAN
SECOND MERIDIAN
MERIDIAN
PRINCIPAL MERIDIAN
SECOND MERIDIAN EAST
MANITOBA
SASKATCHEWAN
NORWAY HOUSE
ONTARIO
River
LAKE WINNIPEG
WINNIPEGOSIS
LAKE MANITOBA
SASKATOON
Saskatchewan R.
REGINA
Assiniboine
River
WINNIPEG
LAKE OF THE WOODS
Red R.
A.
106°
102°
98°
97°27'28"
94°
90°

f the western interior of Canada.

was given and it was all surveyed within a year, but I would not say it was surveyed with the degree of accuracy that we are used to today . . . anyway it was done."

In the early part of the year and as a result of the formidable increase in business being handled by the Interior Department in Ottawa, the offices of Deputy Minister and of Surveyor General (combined in 1879 in the person of Lindsay Russell) were separated. Russell retained supervision of the Technical Branch as Surveyor General. A. M. Burgess was appointed Deputy Minister. During 1883 some 11,300 miles of township lines were surveyed and 1,221 townships were subdivided. This latter operation involved the survey of some 70,000 miles of line. In all, that single season's operations prepared for settlement about 27 million acres, compared with 10,574,915 acres during the entire period 1871-75 inclusive. (These totals do not include the activities of the Special Survey.) The 1883 accomplishment stands unrivalled in the long history of land subdivision in the western world. The surveys extended from the Touchwood Hills westward to the Rockies and northward from the second base line to the North Saskatchewan River. As an immediate dividend this survey enterprise made known to the general public the fact that only a relatively small portion of this vast area was land unsuitable for agriculture.

After eleven full seasons of extensive land measuring in the West, following the suspension of surveys in 1870, the pace of work greatly increased in 1882 and, as we have seen, reached a post-Confederation peak of activity in 1883. Thereafter the Dominion Lands Survey operated on a relatively limited basis. But all was far from well in the vast, newly-opening land. The hard lessons of history had not been completely learned either by officials in Ottawa or by the peoples native to the plains. Some of the grievous mistakes and miscalculations perpetrated by both sides of an issue smouldering since 1869-70 were to be needlessly repeated. Again, the fact and method of surveys lay near the heart of the unrest. But land surveying was not by any means the only factor contributing to discontent. It must be admitted that generally the land surveyors of the 1880s were more diplomatic in their public relations than their counterparts were in 1869. But the buffalo had vanished as an important source of food supply between the Red River and the Rockies. Indians, as well as many people of mixed blood, began to suffer from starvation and general misery.

The appearance of surveyors on the banks of the Saskatchewan River signalled once again to the people native to the region, the remorseless westward surge of white settlers and their civilization which the natives despised. The métis felt the nagging fear that had gripped their kind 14 years previously some hundreds of miles to the east. At St. Laurent near the South Saskatchewan and St. Albert, near the North Saskatchewan, they had settled on long, narrow, river-fronted farms. The prospect of any imposition of the rectangular or other form of land survey repelled them. Nor were the Indians consoled by the government offer of reserves. In addition free traders, selling demoralizing "fire-water" were a continuing problem for the authorities in spite of increasing control of their destructive activities by the North-West Mounted Police, formed in 1873 primarily to combat the prairie menace.

In 1878 petitions from English-speaking half-breeds and from the métis bombarded authorities from St. Laurent, St. Albert, Cypress Hills and Prince Albert. All these documents carried pleas or demands for land grants similar to those made under the Manitoba Act, involving the issue of land scrip.[16] Surveyor General Dennis, to whom the representations were ultimately conveyed in Ottawa, was mindful of his own bitter experiences on the banks of the Red River. He instructed Dominion Land Surveyors that in all cases of half-breed settlements along the rivers, the lands occupied by them were to be surveyed according to the existing river-lot principle. No attempt was made, therefore, to impose the rectangular form of survey on anyone opposed to it. In 1877 and 1878 at Prince Albert and St. Laurent surveys were made accordingly.

But the Council of the North-West Territories felt a continuing deep concern over the rising cannonade of petitions and memorials. The Council urgently suggested to Ottawa a solution to the problem through the issue to every half-breed head of family and child (resident in the Territories) location tickets for 160 acres as well as government aid in the form of farm machinery and seed supplies. Dennis did not completely agree and in proposals of his own, submitted to the Minister of the Interior, he tended to lump together métis and Indians as a single problem. He opposed the giving of scrip because of the marked tendency of the métis to sell such paper for trifling consideration.[17]

Dennis was warned in writing by Archbishop Taché of the delicacy of the situation and of the special sensibilities of the métis over being classed with Indians. All told, some 1,200 families of mixed blood were involved in the general discontent. Federal government action to relieve the unrest was agonizingly slow and thus largely ineffective. Sir John A. Macdonald as Minister of the Interior from 1878 to 1883 cannot escape some blame for the growth of the crisis in the western interior over that period. Possibly his duties as Prime Minister during that same span of time prevented him from giving due attention to matters coming within his purview as a departmental minister. But to some extent Sir John never learned from the Assiniboia tribulation which, in a political sense, he so narrowly survived in the late 1860s. Sir David L. Macpherson, who followed him in the Interior portfolio with senatorial dignity (and who remained in that office for only two years) brought indifferent talents to this exceedingly onerous administrative task.

By 1884 the western situation was ripe for revolt. Debts, poor crops and lack of adequate credit facilities for grain farmers, aggravated the dangerous trend toward the use of armed force. Newspapers were beginning to appear in the more populous settlements on the high plains and their strident, uninhibited editorial voices added to the agitation. All that was needed to fire the explosion among the more extreme elements was a dynamic, politically-minded leader. He did not fail to appear. As a result of the resolution, passed at a public meeting of aggrieved breeds and métis, three men, Gabriel Dumont, Moise Ouelette and Michel Dumas were sent from the valley of the Saskatchewan to find Louis David Riel in Montana and induce him to return as leader of the discontented in Western Canada.[18] They found him at Sun River and their mission proved a success. That was early in June, 1884. Riel showed up at Batoche near Prince Albert in July, eager to assume command and to help redress the grievances of "his" people.

In a sense the North West Rebellion was born at Batoche on March 18, 1885. But it was not until March 26 that any overt act of violence took place. On that day an unplanned clash occurred at Duck Lake between a number of métis, led by Gabriel Dumont, and a detachment of Mounted Police and Prince Albert Volunteers headed by Superintendent Crozier of the North-West Mounted Police. Nine out of 99 on the policing side of the affair were killed and 11 wounded. The métis lost five of their number. In some disorder the Crozier force left the field, retreating to Fort Carlton.

In the spring of 1885 the annual meeting of the Association of Dominion Land Surveyors, organized in Winnipeg in April, 1882, took place in Ottawa. Word of the hostilities at Duck Lake reached the capital while the association was in session and the news caused a considerable stir among those in attendance. Many of these men had surveyed in the North West and realized at once that the outbreak of violence would result in a serious suspension of western survey work for the 1885 season.

On April 1 an informal meeting of the surveyors took place in Russell House, a centrally-located Ottawa hotel, for the purpose of organizing a surveyors' militia unit to take an active part in any military expedition formed to quell the disturbances. After discussion it was decided to ask ten Dominion Land Surveyors to each provide four assistants (men who had seen survey service in the North West and who were familiar with conditions there) to form a corps of fifty men. The following day a deputation waited on Sir David L. Macpherson, Minister of the Interior, who strongly recommended the proposal to his colleague, Sir Adolphe Caron, Minister of Militia. A committee waited on the latter urging official acceptance of the offer of such a corps, armed and mounted, and to act as intelligence men, scouts or as mounted rifles. The scheme was approved after the Minister had consulted by telegraph with the Commanding Officer of the North West expedition, Major-General Federick Middleton. The surveyors were then advised to appoint a captain to command the proposed unit. Arthur Oliver Wheeler, who had qualified as a Provincial Land Surveyor in Manitoba in 1881 and as a Dominion Land Surveyor in the following year, was first offered the post. Although Wheeler had surveyed Canadian Pacific Railway townsites in the West in 1882 and township outlines in the following season, he felt he was not experienced enough in conditions in the Midwest and declined the nomination. The command was next offered to Lewis R. Ord, who had been appointed a Dominion Land Surveyor three years previously. He, too, demurred and John Stoughton Dennis Jr. was then elected.[19]

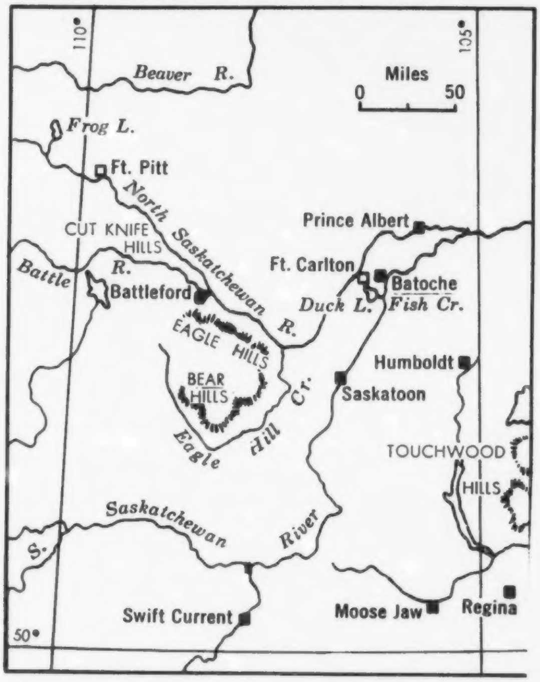

110°
105°
Beaver R.
Miles
0
50
Frog L.
Ft. Pitt
North Saskatchewan R.
Prince Albert
CUT KNIFE HILLS
Battle R.
Battleford
Ft. Carlton
Batoche
Duck L.
Fish Cr.
EAGLE HILLS
BEAR HILLS
Eagle Hill Cr.
Humboldt
Saskatoon
TOUCHWOOD HILLS
Saskatchewan River
S.
Moose Jaw
Regina
Swift Current
50°

FIGURE 21
Scene of military action
1885 Rebellion.

The Dominion Land Surveyors' Intelligence Corps was quickly formed and proceeded by Pullman car to Winnipeg by way of Chicago and St. Paul, arriving in the Manitoba capital on April 11. At Winnipeg more surveyors were recruited for the unit and weapons were obtained as well as saddles and other equipment. The Corps then proceeded to Qu'Appelle where horses were supplied from the winter depot for survey horses. The sequel of this move is related in *Reminiscences of a Bungle*, the memoirs of a corpsman published anonymously but believed to be the impressions of Lieut. Lewis R. Ord:

"Our captain [then] prepared to put us through our drill... "Pre--paretomount! Mount!"

Some of the troopers get up so rapidly that they fall over on the other side; some crawl up like a boy up a greased pole at a fair; here a horse stands as if he had taken root; another pivots round and round on his own axis, and many signify their distaste for riders by bursting from line like lightning from a cloud, bucking strenuously . . . we are about as disorderly a lot as one could care to see . . . some were really good riders but a great many would have felt much safer on the ground where, indeed, several were violently deposited during the first encounter with their chargers."

Orders were finally received to travel on April 20 to Swift Current and from there to serve as a despatch-carrying unit, linking Swift Current to forces in the field. After the engagement at Fish Creek the Intelligence Corps joined the main column of the Expedition. In his special report covering the events of May 10, 1885, Major-General Middleton states: "The Land Surveyor's Scouts, 50 strong, under Captain Dennis, joined my force in the afternoon . . . ". The general, in his diary entries, seemed disposed to avoid use of the more impressive title "Intelligence Corps". Captain Dennis himself frankly admits that the latter name for the unit, though more official, was less correct than the term used by the general as the 'intelligence' it had dared to offer the high command on several occasions "was not looked upon with special favour". Another member of the Corps observed in this connection that "we were looked upon as very small potatoes by the gold-laced gentry of the regular militia". Derisively they were labelled as the "49 officers and one scout" because of the high proportion of commission-holders, 22 out of a total enlistment of 53. Twenty-two men of the Corps were Dominion Land Surveyors, including William Crawford of Milverton, Ontario, the first man to receive a Dominion Land Surveyor's certificate from a Board of Examiners (June 17, 1875). Two other Dominion Land Surveyors, Lieut. E. W. Hubbell and Capt. J. L. Reid, enlisted in the Midland Battalion for the campaign in the North West.

Another important Canadian unit in the Expedition was Boulton's Scouts, a mounted outfit raised and commanded by Major Charles Arkoll Boulton (1841-99), who had been a member of J. S. Dennis's survey crew of 1869 on the banks of the Red. Leader of the Portage Party in those earlier troubles Boulton had been captured by Riel's men and had been condemned to death. His sentence was reprieved by Riel following urgent representations on his behalf. Boulton became a senator in the last year of his life, 1899.

At Fish Creek (Tourond's Crossing), on April 23, Gabriel Dumont and his métis stalled Middleton's advance northward along the South Saskatchewan River. It was at Batoche that the Surveyors' Corps joined the main Middleton force. According to Ord, "Blankets under saddles, Johnson's fluid beef, feed of oats and a tin-billy tied on behind; small package of tea, some hard tack biscuits and corned beef in canteen [two of us] rode out on April 24 with orders for the other half of our unit. Soon [it was] rain and snow . . . "[20]

At the approaches to Batoche, where the métis had dug in for a last stand, the Surveyors' Corps finally came under fire. Renowned for their sharpshooting ability, the métis occupied a defensive ring around the town. The ring consisted of scattered, individual rifle pits. Riel held some ten prisoners in the basement of a Batoche store. On May 9 firing had begun. Fighting continued in this operation over a period of four days. Middleton, to the dismay of his Canadian militiamen, followed a most cautious policy. Soon after the first shots were fired in this engagement he sent his chief of staff, Lord Melgund, later Earl of Minto and Governor-General of Canada, in great haste to Ottawa to plead for the despatch of more men. He little knew the fighting calibre of men already under his command and, least of all, of the redoubtable Surveyors' Corps. Ord takes up the story of events:

"Wheeler suggested that we should go out and occupy one of the rifle pits that had been dug along the top of the river bank . . . and for want of better employment we did so." It was after this sally that Lieut. Wheeler was shot through the muscles of his arm near the shoulder.

May 12, a crucial day in the development of the battle, dawned bright and warm, "... were it not for the sight of the hospital tent and its wounded, and the crack of the skirmishers' rifles near the church, we could almost think it a survey." Middleton had continued in his careful ways and after ordering a partial advance, went to lunch. His repast was interrupted by an outburst of renewed firing and wild cheering. The Canadians, chafing for days under the tight rein of what they considered to be an excessively prudent command, had utilized the mild order to openly charge the rebel rifle pits.

"Handicapped by our heavy boots and spurs and encumbered by our useless revolvers—cheering, laughing, swearing, keeping up an irregular fire into the bush, and yet advancing at a rapid run we charged [if the rush of a lot of undisciplined ragamuffins can be called a charge]. Officers are needless, for we are unanimous in our attentions. There is no red tape to hold us back, the boys have their heads now. The crack, crack of the repeaters come thick and fast. The whistle of bullets tell us the enemy are not idle. Now and again the dull boom of a field gun sounds over the field, followed by the echo of a bursting shell."

In this stirring action, which resulted in the capture of Batoche, the surveyors did not emerge unscathed. Lieut. Thomas Fawcett and Lieut. J. F. Garden were wounded; Garden in the left arm and Fawcett "had buckshot in the chest muscles". The wounding of Fawcett does not appear to have been officially recorded. But the most grievous casualty suffered by the unit was the loss of Lieut. Alexander Walter Kippen. In Middleton's report (page 31) the General states, "I regret to say that one of the surveyors' Scouts was killed, having been shot through the head while lying with the rest of his troop in a bluff on our left". (Only 8 men in all were killed in the Expedition in its attack on Batoche.)

In the words of the surveyor-reporter, "We are a hard and careless lot as a rule, we surveyors, rough associates, hard work, and lack of women's society causes men to grow indifferent to the feelings of others, but I noticed that the troop was quiet and less joking carried on. The first gap had been made in our ranks and we could faintly imagine how Kippen would be missed in the little home circle in Eastern Canada [Perth, Ontario] . . . His quaint sayings and cheerful laugh are gone from No. 1 tent. We cannot realize the sorrow of his parents when the first warning of their loss reaches them in a brief telegram, 'A. W. Kippen, Surveyors' Corps, killed'."

On May 15 and for some days following, the Surveyors' Corps and Major Boulton's Mounted Infantry were ordered to round up hostile Indians (Big Bear and his followers) and any rebel fugitives. Riel was brought into camp by scouts and was received courteously by Middleton. The Surveyors' Corps moved into Prince Albert after the capitulation of Batoche and was then detailed to escort the transport train to Battleford. As part of the chase after Big Bear the Corps then moved on to Fort Pitt and into the wilderness near Beaver River and Cold Lake. It was during this stage of the campaign that the experience of surveyors and of surveyors' assistants proved most useful. Moving through rough country they opened roads, corduroyed swamps and muskegs and surmounted various kinds of natural obstacles. Returning to Battleford the Corps was detailed to establish a picket line along the south bank of the South Saskatchewan River to intercept hostile Indians heading south. During this period a number of Indians were arrested, among them some who had participated in the Frog Lake massacre and who were hanged for their crimes at Battleford.[21]

A memorable incident during the May 12 fighting is reported in Middleton's despatch of that day, "In the middle of our firing I saw a man riding towards me, waving a white flag. I rode forward to meet him and found it was Mr. Ashley [sic], a surveyor, one of the men who had been made captive by Riel. He told me he had just come from Riel, who was apparently in a great stage of agitation, and handed me a letter from him in which he said that if I massacred his women and children (by shellfire) they would massacre *their* prisoners . . . ".

John William Astley faced the dismal task of returning to the distressed Riel with a reply from Middleton. In the outcome the prisoners were not harmed but Astley at the time could hardly have felt complete assurance of the safety of himself and his fellow captives.

Astley is described by Middleton and by others as a surveyor but his name does not appear in any professional list of the time, provincial or federal. He was a witness for prosecution at the Riel trial in Regina and was sworn as such on July 28, 1885. G. W. Burbidge, Q.C., asked of him the nature of his occupation. "Civil engineer, land surveyor and explorer", replied Astley, "I reside at Prince Albert, having been there about three years. During that time [I] engaged in land surveying and exploration . . . ". It is unlikely that Astley ever was in charge of a field party on survey work but he could have been one of a party serving under a qualified surveyor in any one of several capacities. He could not have signed a surveyor's plan that would carry any official validity.

On June 30 the Dominion Lands Surveyors' Intelligence Corps rode to Moose Jaw, there to disband.[22] In his report of May 12 Middleton paid a high compliment to the Corps commander, "Captain Dennis, commanding the Surveyors' Scouts, did excellent service and deserves great praise for the way in which he handled his men."

The Corps contained a number of men who later distinguished themselves in surveying and in public life. John S. Dennis Jr., later became assistant to the president of the Canadian Pacific Railway and chief commissioner of its immigration and colonization development activities. He was made a Companion of the Order of St. Michael and St. George. G. H. Brabazon became a member of parliament for Pontiac; Thomas Fawcett on three separate occasions was made a president of the Association of Dominion Land Surveyors; B. J. Saunders was named, in the course of time, honorary Lieut.-Colonel of the 101st Regiment, Edmonton Fusiliers, and A. O. Wheeler made a national reputation as a mapper and surveyor in the Rocky Mountains and other rugged regions of the Far West.

J. J. Burrows, appointed a Dominion Land Surveyor in 1878, served as quartermaster of the Corps and so distinguished himself in that post that on one occasion his commanding officer was paraded before Major-General Middleton to answer a complaint from the commissariat. The commissariat officers stated that Quartermaster Burrows and his detail would swipe the very fillings out of their teeth unless they slept with their mouths tightly shut![23]

The activities of the Corps in 1885, in the estimation of their commander, proved the special adaptability of men of the surveying profession. They were able to participate effectively in military operations and to care for themselves resourcefully in a new and somewhat unknown country. Most of the men forming the Corps had experience in prairie transport and camping as well as in the use of firearms. As Capt. Dennis put it, "the work performed [by the Corps] may, I think, be reasonably included in the statement of the important work done by the surveyors of Canada in the development of our great Western territory."[24]

The names of all those who served in the Dominion Land Surveyors' Intelligence Corps (with rank and home address) follow in alphabetical order:[25]

Land Surveyors' Intelligence Corps

North West Rebellion, 1885

Anderson, Robert	Tpr.	—
Ardesi, John Plummer	Lieut.	Ottawa
Beatty, Walter	Lieut.	Delta
Blanchett, Louis	Tpr.	Ottawa
Bourgeau, Francis	Tpr.	Aylmer, Que.
Brabazon, Gerald Hugh	Tpr.	Portage du Fort

Burrows, Josia Joseph	Lieut.	Ottawa
Campbell, Charles	Tpr.	Portage du Fort
Chaloner, Wilfrid Edouard	Tpr.	Quebec
Cornock, William Bromley	Tpr.	St. Thomas
Crawford, William	Lieut.	Winnipeg
Cumming, Frank William Chambers	Tpr.	Ottawa
Dennis, Henry Joseph	Tpr.	Toronto
Dennis, John Stoughton	Capt.	Ottawa
Denny, Herbert C.	Lieut.	Toronto
De Renzy, William Edward	Tpr.	Ottawa
Driscoll, Alfred, Jr.	Tpr.	Aylmer, Que.
Ellis, Henry Disney	Lieut.	Toronto
Fawcett, Adam	Tpr.	Gravenhurst
Fawcett, Thomas	Lieut.	Gravenhurst
Garden, James Forde	Lieut.	Toronto
Giles, Thomas	Tpr.	Prince Albert
Gore, Thomas Sinclair	Lieut.	Regina
Hawes, Albert	Tpr.	Winnipeg
Henderson, Thomas	Tpr.	Winnipeg
Hunt, John	Tpr.	Winnipeg
Johnston, James	Tpr.	Toronto
Kelly, Henry Diel	Tpr.	Elora
Kippen, Alexander Walter	Lieut.	Perth
Maddock, James Arthur	Lieut.	Lindsay
Martin, Frank	Tpr.	Toronto
McLatchie, John	Lieut.	Winnipeg
McLean, James Keachie	Lieut.	Elora
McVicar, James Malcolm	Tpr.	Winnipeg
Mills, George	Tpr.	Moose Jaw
Milne, James	Tpr.	Collingwood
Morrison, Malcolm	Tpr.	Winnipeg
Mowat, John	Tpr.	Regina
Ord, Lewis Redmond	Lieut.	Toronto
Ord, William Botsford	Tpr.	Toronto
Perry, Charles Bruce	Tpr.	Toronto
Popham, Charles	Tpr.	Winnipeg
Russell, Thomas Sinclair	Tpr.	Ottawa
Saunders, Boyce Johnston	Lieut.	Farmersville
Shna, William	Tpr.	Prince Albert
Small, Wolstan	Lieut.	Ottawa
Snow, John Frederick	Lieut.	Winnipeg
Sproat, John	Tpr.	Moose Jaw
Stephen, Arthur	Tpr.	Collingwood
Torrance, Wilfred	Tpr.	Ottawa
Wheeler, Arthur Oliver	Lieut.	Ottawa
Wolff, Charles Edward	Lieut.	Ottawa
Woodley, Richard Clifton	Tpr.	Ottawa

Surveying was one of the earliest manifestations of federal authority in the fast-developing western interior of Canada and because of this much unwarranted blame has been laid on the shoulders of surveyors for the civil troubles of 1885. A feature editorial entitled "Why Blame the Surveys?" in Volume One, Number 7 of the Journal of the Dominion Land Surveyors' Association, deals with various misconceptions arising from the key role played by land surveyors in the West. The editorial quotes from the statement made by the Deputy Minister, Department of the Interior, in the departmental report of 1885:

"As a matter of fact, in no case where settlers have been found on a river front in advance of survey, and desired that their holdings should be laid out with river frontages, has the privilege been refused. Details of this sort must necessarily be left largely to the discretion of the surveyors who are entrusted with the work of sub-division, and as the average cost of the river survey is about nine times as great as that of a rectangular survey, and the profits of the sub-divider are large in proportion, it is needless to say that there has been no desire on the part of the surveying profession to refuse to accede to the wishes of the settler in this respect. Indeed the only complaint which has reached the Department about surveys has come from the South Branch of the Saskatchewan and from French Half-breeds who went into possession of their holdings long after the land had been surveyed on the rectangular principle and in respect of these the Department has always been ready to practically meet their wishes by allotting to them their holdings in legal sub-divisions, which would give their lands with narrow frontages upon the river and extend them back one or two miles as the case may be, just as if they had been laid out on the river system from the beginning."

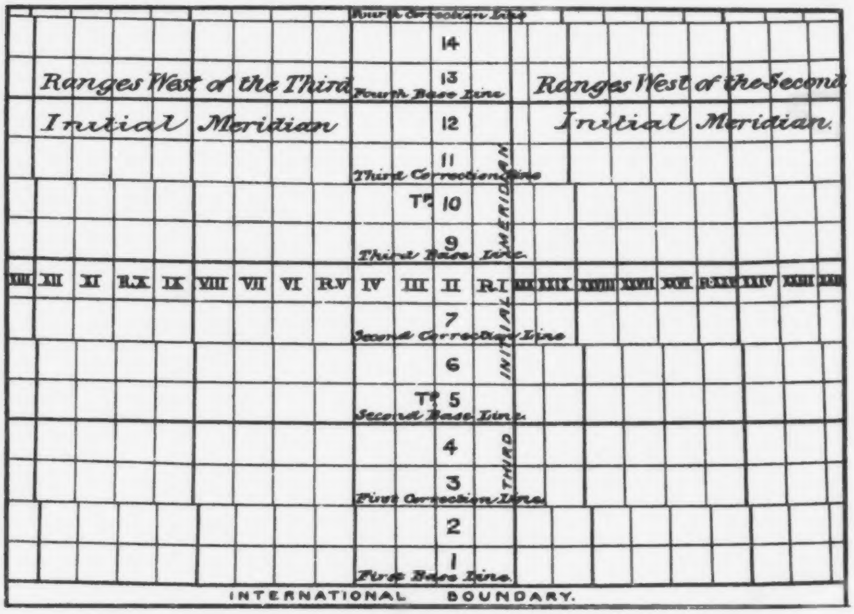

Fourth Correction Line
14
13
Fourth Base Line
12
Ranges West of the Third Initial Meridian
Ranges West of the Second Initial Meridian.
11
Third Correction Line
Tp 10
9
Third Base Line
XII
XI
R.X
IX
VIII
VII
VI
R.V
IV
III
II
R.I
7
Second Correction Line
6
Tp 5
Second Base Line
4
3
First Correction Line
2
1
First Base Line
THIRD INITIAL MERIDIAN
INTERNATIONAL BOUNDARY.

FIGURE 22. Diagram portraying method of subdividing western interior into blocks and townships. Note jogs in correction lines.

Land surveying procedure in the western interior of Canada in the 1870s and 1880s followed a well-defined pattern. In the 1883 manual, for instance, the procedure to be followed was that the country was laid out into blocks, each consisting of 16 townships, 4 in longitude and 4 in latitude, bounded east and west by broken meridians, the lines of which were separated by jogs at the correction lines.* Each township, as we have seen, was 6 miles square, and each row of townships northward was known as a range, and ranges were numbered consecutively westward. In outlining one of these blocks the surveyor first ran the base line across two ranges, adjusting his bearings at the midway township corner by a stellar observation. He next ran the meridian lines northward and southward to the correction line, noting the closure. Provided that the meridian line from the other direction had been surveyed to the correction line, any error in closing was distributed equally between the two quarter-sections immediately adjoining the correction line. In running base and correction lines or meridian exteriors, instruments of the best make available were used, graduated to at least ten seconds of an arc. The transit-theodolite without vertical circle and with six-inch limb was recommended for use in this connection. For township subdivision or traversing a transit-theodolite or solar compass accurate to two minutes, was regarded as sufficient. The chain used was the standard Gunter's chain, 66 feet long (100 links) tested and corrected frequently during use.

The astronomic meridian was determined by observation of the elongation of Polaris at night. A point was fixed not less than 150 yards distant from the transit directly below the star at elongation. The line through this point and the point directly underneath the transit made an angle with the true meridian equal to the azimuth of the star. On block outlines an observation was required at least on every township outline. Both banks of all navigable rivers and on all lakes and deep ponds extending more than 25 acres, together with any islands, were traversed.

In 1872 a map was issued at Ottawa showing the surveys completed in Manitoba and the North-West Territories. This constituted the first official map of the newly formed province and depicted the results of surveys of Dominion Lands.

A history of Dominion Lands surveys would be incomplete without a description of methods of monumentation employed. Various types of monuments or markers were used, depending on whether open prairie or bushland was being surveyed. From correspondence in old files in Ottawa it would seem that surveyors in the field were not always aware of changes in regulations concerning boundary posts, or were not always in a position to abide strictly by formal instructions given them.

In bushland from 1871 to 1880 if a tree was found at an exact corner of a section it was required to be squared and marked on four sides. It might, in some instances, be cut down and a survey post substituted. During that same span of time wooden posts, squared at the top and marked on four sides, could be used. In regions where stone was plentiful township corners would be denoted by a single marked stone with a pyramid of smaller stones alongside. On open prairie, township corners were usually marked by iron post, mound, trench and pit, the entire monument being an exact duplicate of monuments erected on United States public lands surveys from 1871 to 1880. In the 1880s iron posts were used in stone mounds and pits.[26] After 1886 earth mounds were to be discontinued on prairie rangelands where cattle often tended to paw them down. Surveyors' field notes of those days, however, reveal that some mounds were erected after that year in such areas. From 1871 to 1915 on township corners only, iron posts, 5 feet long and 1⅜ inches square, marked on four sides, were used in conjunction with regulation pits and mounds. Smaller iron posts were used on section corners. For a time, on open prairie, a wooden post in a stone mound would suffice, if stone was readily available.

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*Correction lines absorb the convergence of meridians and are intermediate to base lines.

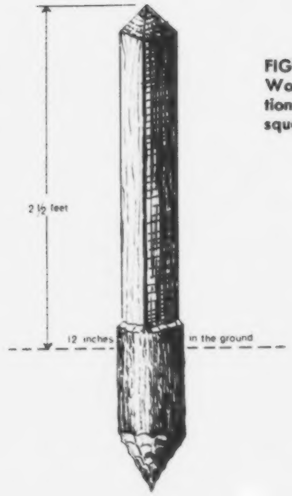
2 ½ feet
12 inches
in the ground

FIGURE 23
Wood post, marking section corner. 5" diam., 3½" squared.

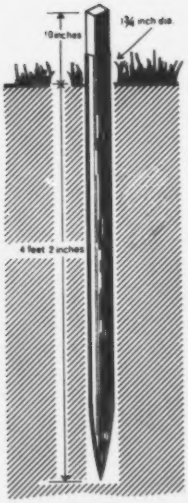
10 inches
1¾ inch dia.
4 feet 2 inches

FIGURE 25
Iron post marker, township corner.

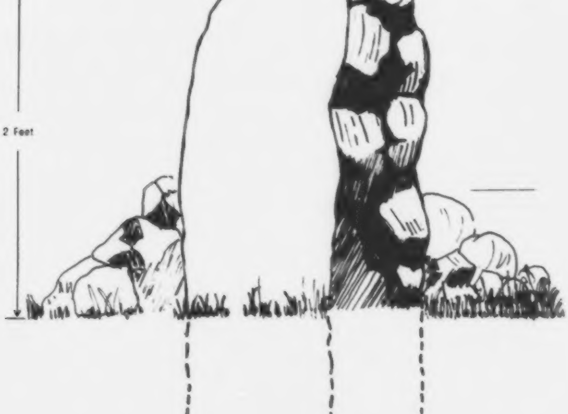
1 Foot to 18 inches
2 Feet

FIGURE 24. Stone marker, township corner.

Generally speaking, the chronological order or progress in the use of boundary markers was from the early wooden and stone posts to solid iron posts at township corners, to small-diameter iron tubes (44 inches long by ½ inch diameter) with flat tin plates, 6 inches square, and then to iron pipe posts (3 feet long by ¾ inches diameter) with upper end squared and stamped with a crown on one face. It also bore the following inscription: "Penalty for Removal, Seven Years Imprisonment". By 1915 standard iron posts with bronze caps were in use.

Deville has provided a telling glimpse of some of the difficulties he faced in his efforts to improve survey monumentation on Dominion Lands.

"Now that was one of the first things I did when I joined the Service [1880]—it was to urge the substitution of iron posts for the wooden posts hitherto used. The posts in that [western] country were mostly of poplar and those were of no use whatever as the numbers disappeared from them in a few years, so I asked that we be allowed to use iron posts. Well, the Minister [Sir John A. Macdonald] did not believe in accurate surveying or any permanent surveying or anything like that—he had a notion of his own and would not listen about iron posts at all—the wooden posts were good enough for him. I tried to bring forth all the arguments I could for iron posts and among them I pointed out that in surveying the open prairies there was no wood there and we would have to carry our cumbersome wooden posts with us. I pointed out the convenience of the iron posts in comparison, and the Minister said to go ahead and use them, but the surveyors would have to pay for them. Well", Deville concluded with a disarming smile, "we got the iron posts anyway and I don't think the surveyors paid for them!"[27]

But in 1882 when iron posts began to be used at section corners these were planted in the centre of mounds with two inches projecting above. On top a square tin plate with appropriate markings was slipped over the post and held in place by wire or nail. Inscriptions on wooden posts were usually made by knives or scribing irons; on iron posts by cold chisel and on tin plates by special dies. On township corner iron posts dies were used also.

When a township corner occurred in a shallow marsh or swamp, requiring a witness monument more than 5 chains distant from the true corner, the latter had to be marked also by a long wooden post, marked on one side. A witness monument was one serving as a marker for a corner removed an even number of chains from the witness. The latter marker was made necessary whenever a corner was located in a road allowance, lake or other body of water or in any position where it might be destroyed by human or natural action. Usually the witness post carried the inscription "Wt." together with details of distance and direction from the true corner, measured in an even number of chains. A bearing tree could serve as a witness and, on the basis of convenience, could be in any direction from the true corner. For example, in the August 20, 1872 field notes of Deputy Surveyors David and Walter Beatty, the following record is found in relation to Swan Lake Indian Reserve No. 7 in Manitoba: "Bearing tree (0.11 chains S 67°W of the NE cor., sec. 5, Tp. 5, R 11 WPM) blazed by Walter and David Beatty, DS, on 20 day of Aug., 1872, when it was a 6″ oak."*

Deville's account of his encounter with Sir John was his characteristic, off-hand way of describing his own inflexible determination and ability to win a point despite disapproval in the highest quarters. He might also have mentioned in this account the frustrations experienced by some pioneer surveyors on the Portage Plains in this matter of posting. Indians would follow the survey parties at a respectable distance, and lift the wooden stakes for use as firewood in their camps. If the white man was foolish enough to leave such stakes behind him in a treeless land, what else could a wise Indian do?

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*Part of tree trunk is on exhibit with permanent collection of Canadian landmarks in possession of Legal Surveys, Department of Energy, Mines and Resources, Ottawa.

On March 7, 1871, Dennis was made Surveyor General of Dominion Lands and in the same month the control and administration of those lands were transferred from the Department of Public Works to the State Department. In April, by Order in Council, the new survey system for the West had been approved officially and legally adopted. With the formation of the new Dominion Lands Branch and the publication on May 1st of the initial edition of the *Manual of Survey, Dominion Lands*, the measurement and bounding of townships, sections and quarter-sections of the western interior of Canada could formally commence.

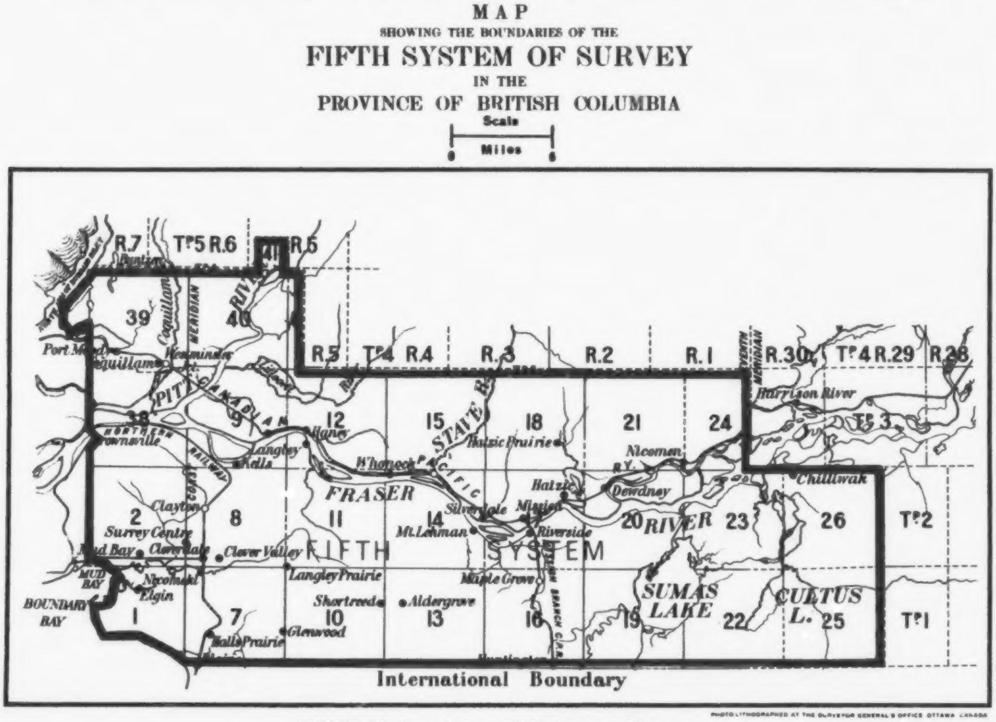
MAP
SHOWING THE BOUNDARIES OF THE
FIFTH SYSTEM OF SURVEY
IN THE
PROVINCE OF BRITISH COLUMBIA
Scale
Miles
R.7
Tp5 R.6
R.5
39
40
Coquitlam
MERIDIAN
RIV
Port Moody
Coquitlam
Westminster
R.5
Tp4 R.4
R.3
R.2
R.1
SEVENTH MERIDIAN
R.30
Tp4 R.29
R.28
Harrison River
Tp3
PITT
CANADIAN
NORTHERN
RAILWAY
38
9
12
15
18
21
24
Haney
Hatzic Prairie
Nicomen
Langley
Wells
Whonock
PACIFIC
STAVE R.
Hatzic
Dewdney
Chilliwak
FRASER
Clayton
2
8
11
14
Silverdale
Mission
20
RIVER
23
26
Tp2
Surrey Centre
Mt.Lehman
Riverside
Mud Bay
Cloverdale
Clover Valley
FIFTH
SYSTEM
MUD BAY
Nicomekl
Langley Prairie
Maple Grove
Elgin
BOUNDARY BAY
1
7
Shortreed
10
Aldergrove
13
16
19
SUMAS LAKE
22
CULTUS L.
25
Tp1
Glenwood
Bell's Prairie
International Boundary
PHOTOLITHOGRAPHED AT THE SURVEYOR GENERAL'S OFFICE OTTAWA CANADA

FIGURE 26. Boundaries of Fifth System of Survey.

In his prefatory note in the initial 32-page Manual the Surveyor General explained that "in preparing the accompanying Instructions to Deputy Surveyors, use had been made, where the same would apply to the system of Survey adopted by the Dominion, of the very complete Manual published by order of the Commissioner of the United States Land Office, dated 1855; and subsequent instructions to Surveyors General of the United States by that officer, dated 1864."

The 1871 Manual, with its collection of eight diagrams rather inelegantly tipped in at the back of the book, remained in use for 10 years. Under its provisions a large part of the Canadian West was surveyed. It formed the basis for succeeding editions issued to cover various systems of survey as these evolved over the years. For example, the reduction in 1881 in the width of road allowances and the abolition of three east-west roads in a township survey were changes that led to the issue on March 17 of that year of the second (86-page) edition. A third edition of 117 pages appeared two years later, on June 1, 1883.

Each of these three early publications constituted a book of detailed instructions for the guidance of surveyors as well as a source of general information on the nature of the surveys to be undertaken. As the title pages of the second and third editions declared, "Manual shewing the System of Survey of the Dominion Lands with Instructions to Surveyors." Each manual explained various features of the survey system to be followed, and indicated ways of obtaining maximum accuracy as well as methods of defining a meridian line. It described monumentation and the designation of boundaries, types of corner posts and markers required, instruments to be used as well as the manner in which surveyors' plans and field notes were to be submitted to headquarters. Each plan was to provide a clear record of the nature and position of all boundaries in the survey as well as topographic features serving as references to such boundaries. Field notes were to show exactly how lines were run.

The 1883 Manual stated that the Second System of Survey "is similar in all respects to the First System except in regard to the deficiency or surplus from converging or diverging meridians, which is distributed equally between all quarter-sections as in the actual system." But there were other important differences. In the 1881 edition Lindsay Russell as Surveyor General stated that the (second) edition had been prepared by Deputy Minister Dennis of the Department of the Interior. Incidentally, in 1876, William F. King had become astronomic assistant to Lindsay Russell. Russell explained that this second edition of the Manual had become necessary because the first edition was out of print and also because of changes in the width of road allowances (from 1½ to 1 chain) and "certain other modifications of the processes of the survey" so that appropriate alterations of text were necessary. "These", he wrote, "have been made under my direction by Captain E. Deville, D.T.S., F.R.A.S. Several useful tables have been added in this edition." Russell indicated that these tables had been compiled by Deville and King, names that came to sparkle brightly in the wide firmament of Canadian surveying and mapping.

Both the second and third Manuals, published by Maclean, Roger and Company of Ottawa, included two plans in color. The third edition, in particular, contained numerous diagrams and featured a large increase in the number of mathematical tables used "to facilitate necessary calculations" by surveyors in the field. Each Manual emphasized that all these surveys were to be astronomic and therefore performed independently of the magnetic needle. The surveyor was to carry a sidereal pocket chronometer, preferably a lever watch, to aid him in this connection. All measurements were to be made with a four-pole chain, tested at the Dominion Lands Office, Ottawa, as well as in the field every other day in order that any adjustments might be made because of temperature changes.

Field notes were required to be faithful, distinct and a carefully minute record of everything officially done and observed by the surveyor and his assistants "pursuant to instructions". The notes were to include descriptions of creeks, the nature of the water in lakes, the type of land surface observed, types of soil and timber stands, details of waterfalls, coal deposits and minerals—in brief, a general description of the entire township being surveyed. Plans were to show, on a scale of 40 chains to the inch, precise measurements of quarter-sections, topographical objects, direction of streams, location of ponds, swamps, ravines, muskegs, lakes and hills.

The cost to the federal government of early land surveys in the western interior is a matter of considerable historical interest. On May 11, 1871, an Order in Council was passed at Ottawa providing for daily rates of pay for members of survey parties working in Manitoba and the North West, as follows:

One Deputy Surveyor	$ 4.00
Two chainmen ($1.00 each)	2.00
Two axemen or flagmen	2.00
One cook	1.00
One horse and cart	1.00
Allowance of 60 cents per day to surveyor to cover cost of rations	3.60
Daily cost of survey party	$13.60

The camp equipment allowance for a season totalled $150.00 in these early days. Such equipment included tents, hardware, cooking utensils, dishes, plates, cutlery, candles, oil and soap, towelling, cooking stove, camp stove, blankets, tools, rope, twine, wire, axes, brush-hooks, spades, grindstones, whetstones, scythes, pack-straps, survey pickets, chain-pins, scribing-irons and instrument boxes. There was a standard allowance of $10.00 for stationery. Anything other than these supplies had to be provided by the surveyor in charge or by the men themselves. William Pearce, D.L.S., claimed in his reminiscences that as late as 1874 men of a survey party supplied their own blankets.[28]

The 1871 Order in Council was amended by an Order dated March 1, 1872. Under this revision the pay of surveyors on settlement and timber limit surveys was raised from $4.00 to $5.00 per day in addition to the provision of the actual cost of hiring men. The surveyor, in addition, received for himself and each man of his party 60 cents per day as a ration allowance as well as a reasonable charge for camp equipment and the transport of men and supplies.

All Dominion Lands surveys in 1871 and 1872 were performed under the contract system at so much per mile as follows:

Type of Survey	*Open Prairie*	*Poplar Woods*	*Other Woods*
Block outline	$ 9.00	$15.00	$25.00
Township subdivision	7.00	11.00	18.00

Note: "Other Woods" included heavy timber or windfall, dense bottom scrub with vines or thick willow, or hazel.

For the purpose of making necessary measurements and placing section and quarter-section corners on one side of the road allowance on a correction line, the other limit of such road allowance having been run and marked, it was understood that the surveyor would be paid at a uniform rate of $8.00 per mile.

Towards the end of the 1872 season in the western interior, surveyor-contractors engaged on block outlines became bitterly discontented over the poor financial rewards attending their heavy work and heavier responsibilities. They described to Lindsay Russell the magnitude of the difficulties under which they labored in comparison with the stipulated rates of pay. The pay scale, in fact, was represented as being so low, and the need for accuracy in surveys so great as to make daily progress anything but rapid. It was claimed that in these circumstances surveyor-contractors could not possibly break even financially on a season's operation. It was all they could do to meet daily expenses of their survey parties, let alone secure any compensation for their personal services.

Russell became convinced, in the light of actual experience in the field, that it would be fairer to both the government (through the production of accurate results) and the surveyor-contractor if the latter worked on the basis of daily pay and allowances. Accordingly Russell, in a memorandum dated April 17, 1873, made representations along these lines to the Surveyor

General. Dennis agreed with the submission and five days later new regulations became effective on the subject. The 1872 Order in Council was amended and block outline surveyors were accorded daily pay, such payments not to exceed $6.00 per day. Contractors, however, were given the option of accepting the new system of remuneration or payment at rates specified in their contracts. On May 12, 1875, rates for subdivision work were again amended and new rates based upon distances of surveys from certain specified fixed points were introduced.

In the meantime a new department of federal government had been created, the Department of the Interior. In May, 1873, the Act of Parliament creating this department received royal assent and on June 30 the management and control of Dominion Lands was transferred from the Department of the Secretary of State to the Department of the Interior. The office of Minister of the Interior was created by 36 Vic. c. 4 which came into force on July 1, 1873. The first occupant of the Interior portfolio was Hon. Alexander Campbell, the Ontario statesman who had had so much to do with the Dominion Lands Survey regulations of 1871. A general election and the subsequent arrival in office of a Liberal administration cut down Campbell's term of office to a few months only. The first Deputy Minister of the Interior was E. A. Meredith. On August 13, 1873, an Order in Council recommended that the organization of the new department consist of 29 persons including the Deputy Minister, a Deputy Superintendent General of Indian Affairs, a Surveyor General, a Commissioner of Ordnance and Admiralty Lands, 20 clerks of varying grades and 3 messengers. The Geological Survey of Canada was attached at this time to the Interior Department and its Museum moved from Montreal to Ottawa. In 1872 Milner Hart and A. H. Whitcher had been appointed Assistant Inspectors of Surveys in the Dominion Lands Branch taken over by the Department of the Interior a year later.

Allowances to surveyors were again revised by Order in Council dated May 17, 1887. Under this authority the rates for "board" for one season were set out as follows:

Board for one season for block surveyors,-	
Manitoba and North-West Territory	$250.00
British Columbia	300.00
Township outline surveyors and examiner of contracts,-	
Manitoba and North-West Territory	200.00
British Columbia	250.00
Explorer and surveyor of trails, Manitoba	160.00

Payment for surveying traverse lines was fixed at the rate of $9.00 per mile east of the Fourth Meridian and $10.00 for lines west of that meridian.

In making cost comparisons between Crown Land surveys in Upper and Lower Canada on the one hand, and Dominion Lands survey work in the 1870s on the other, it must be borne in mind that in the case of the former only one boundary of a lot—the front line—was surveyed whereas in the Dominion Lands Survey System all four lines were drawn. The average cost of surveying block outlines in the West, according to the 1876 annual report of Surveyor General Dennis, was $36.83 per mile. The average cost of surveys in Central Canada from 1841 to 1876 was $6\frac{1}{10}$ cents per acre, each mile bounding 200 acres. The Dominion Lands township surveys cost was 3.83 cents per acre, each mile bounding 160 acres.

In reading the records of the Allison Commission of the United States Congress in the mid-1880s one realizes that American authorities were greatly impressed by their discovery that Canadian land survey costs in the western interior were substantially lower than similar survey work in the western states. One witness of status testified before the Commission that the rectangular system of survey in the United States but adapted to Canada's western interior "had been executed by refined methods, so that the land office surveys will ultimately constitute the basis of a topographic map and of cadastral maps, and many millions of dollars will thereby be saved. This superior work has been accurate at less expense than corresponding work in the United States."[29] On at least one occasion of note, the difference in cost of the land surveys in the West of each country was estimated at eighty millions of dollars!

Red Fife, the first wheat strain to combine hardiness with good milling quality, as already indicated, was an important key in the opening up of Manitoba and the North West to rapid settlement. Two other keys essential to swift development of the freshly-surveyed inland empire were the free homestead system and the railway land-grant policy. Grain production soon began to mount on the western plains. The first shipment of wheat from Western Canada was in October, 1876. It began its epic journey from Winnipeg by Red River steamer and consisted of 857½ bushels of Red Fife at 85 cents per bushel. The shipment was consigned by Higgins and Young, Winnipeg, to Steel Brothers, Toronto, for use in Ontario as seed.*

If some of the growth troubles arising out of the transformed West can be attributed to land survey policy or activities, many of the benefits of settlement and economic development can also be accorded to the courage, endurance and enterprise of surveyors and their assistants. Difficulties with métis and Indians, lack of rail or telegraphic communications, long, rough and very trying rides in Red River carts, rigors of the climate, encounters with swamps, muskegs, foul water and insect pests, all failed to repel the land surveyor. With patience, persistence and occasional bursts of bad language, he triumphed, with his men, over adversities that must have taxed his stamina to the utmost. Yet he gave a most excellent account of himself. The prosperous, occupied lands of the western interior today stand as a lasting memorial to his resourcefulness, dedication and almost unlimited capacity for hard, accurate and sustained work.

In July, 1930, at a time when the natural resources were being transferred to the three provinces of the western interior by the Dominion, a monument was erected by the Historical Sites and Monument Board of Canada on a plot of land donated by two prominent citizens of Manitoba.** That site is located on what is now the Trans-Canada Highway at a point near Headingly, west of Winnipeg. The inscription on that monument reads:

"The first Monument on the Dominion Lands Survey was placed July 10, 1871, on the Principal Meridian, about half a mile north of this site. The system, then inaugurated by Lieut.-Col. John Stoughton Dennis, Surveyor General, extends across the Prairies and to the Pacific Coast. It now embraces more than 200 million acres of surveyed land in Manitoba, Saskatchewan and Alberta and parts of British Columbia."

These millions of acres constitute, in all probability, the largest block of land ever surveyed under a single, integrated system. In the words of W. F. King, uttered when he was Inspector of Surveys, "the surveys of the North West as regards accuracy, economy and rapidity of their execution, can compare favorably with those of any country in the world."[30] The Headingly monument is a fitting, permanent tribute from the Canadian nation to the authors of a plan of land division and subdivision exceptional in its concept and immense scope. It is a standing salute as well to the surveyors who, despite many formidable natural obstacles and severe physical trials, efficiently and with a high degree of accuracy carried that ambitious plan into practical effect.

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*A plaque in the Legislative Buildings, Manitoba, commemorates this event.

**Senator J. T. Haig and Hon. A. Benard. The monument was unveiled on July 14, 1930, on the occasion of the 50th anniversary of the Association of Manitoba Land Surveyors.

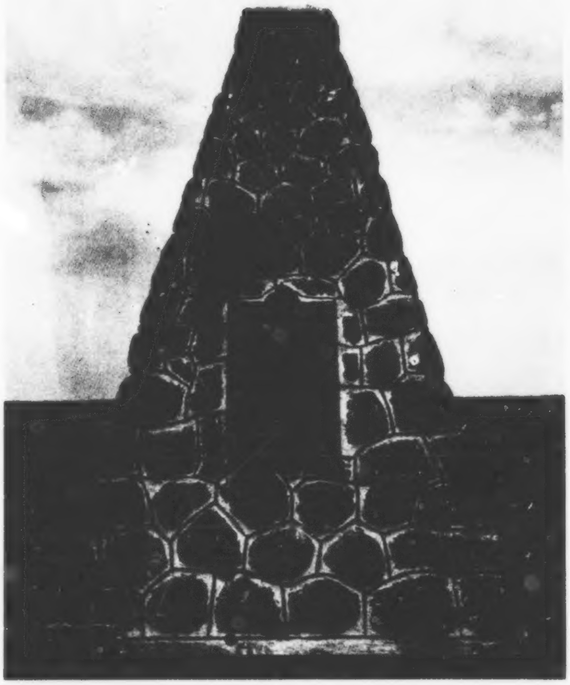

FIGURE 27
Monument to Dominion Lands Survey System at Headingly, Manitoba, on the Trans-Canada Highway just west of Winnipeg.

4

ORIGINS AND EARLY YEARS OF SURVEYORS' ORGANIZATIONS

"The Duke of Buckingham's Surveyor? ha? Where's his examination?"
King Henry VIII, Act 1, Sc. 1

Before the close of the 19th century four important organizations of land surveyors had been formed in Canada. Three of these were duly incorporated by legislative enactments in their respective provinces, bodies "politic and corporate, with perpetual succession and a common seal." Strangely enough the first such organization came into being in the newly-created province of Manitoba. On April 24, 1874, a group of surveyors met in Winnipeg. There were eleven present: Charles-J. Bouchette, C. P. Brown, O. B. Davidson, John Grant, J. W. Harris, A. F. Martin, George McPhillips (1848-1913), John L. Reid (1841-1911), A. L. Russell, Duncan Sinclair and Amos H. Vaughan (1809-97). The meeting passed a motion that "it is advisable that the Land Surveyors resident in Manitoba and the North West Territories form themselves into an Association for the better organization of the profession and that the Association be composed of Deputy Surveyors employed under instructions of the Dominion Land Office and duly qualified Land Surveyors from any of the Provinces of the Dominion." A telegram was sent from this meeting to Surveyor General Dennis as follows: "Land Surveyors formed Association. If the Land Act is before Parliament please propose to change Deputy Surveyor to Dominion Land Surveyor." Dennis at Ottawa complied with the request and as a result federal government surveyors were granted the title borne by them ever since. This transaction had a far-reaching effect on western surveying as it marked the beginning of personal responsibility on the part of the individual surveyor for his work.

A committee of this initial meeting was instructed to draft a bill designed to regulate land surveys in Manitoba and to authorize incorporation. For six years, however, nothing much happened in this regard. But in 1880 a second meeting of surveyors was held at which A. H. Vaughan was named president and J. S. Dennis Jr., vice-president. It was in this same year that the Dominion Land Surveyors' Board of Examiners held a meeting in Winnipeg and gave Dominion Land Surveyor commissions to some 30 provincial land surveyors.

Federal

A. H. Whitcher, Inspector of Surveys, Dennis and Robert Bourne (1844-1905) formed a committee empowered to draft a constitution for an Association and in mid-December, 1880, a constitution was adopted and officers elected. There is evidence that the first name proposed for the new organization was "The Association of Dominion Land Surveyors of Manitoba and the North-West Territories". In the bill of incorporation passed on May 25, 1881 (44 Vic. ch. 29) the name, however, appeared as "Association of Provincial Land Surveyors".

At the first annual meeting after passage of the bill, namely, on June 20, 1881, J. S. Dennis Jr., was elected president and George McPhillips, vice-president. The secretary-treasurer, J. W. Harris, held that post from 1881 to 1904. The executive committee consisted of W. Wagner, T. Breen and Joseph Doupe. By 1882 the Association claimed 80 members. From 1890 to 1900 only two new members were added to the roster. Among those who joined in 1883 were O. J. Klotz, Thomas Fawcett, W. F. King, Milner Hart, P. R. A. Belanger, C. -J. Bouchette and A. O. Wheeler.

J. S. Dennis Jr. (1856-1938) has related how, during this formative period in the career of the Manitoba organization he achieved distinction by being jailed in his capacity of Association president.

Dennis tells the story of his imprisonment with considerable relish: "When our bill passed the Manitoba legislature a clause was sneaked into it without the knowledge of the Association committee looking after it. The clause provided that any man who had served under articles for a period of two years should be entitled to his diploma without examination. Naturally we were very much concerned about that, and very much surprised to find it in the bill. But there it was, it had become law and immediately after there was a demand made upon Association officials and upon me as President to sign the diploma for a man who had served only two years and had not passed any examination. After serious consideration we decided we would not do it, and I refused to sign the diploma. A writ of mandamus was applied for and issued and I, as President of the Association, was ordered under the writ to sign the diploma. Being young and reckless I continued to refuse and in consequence a husky policeman came and escorted me to jail. After I was in jail a few hours some citizens thought it well to bail me out and subsequently the case came on for hearing. It was tried before a very explosive gentleman, Chief Justice Wood, known in the House of Commons where he once served as "Big Thunder". He had only one arm but he had a very powerful voice and when I was paraded before him to explain why I had refused to obey the order of the court, I nearly expired when, in his characteristically explosive way, he outlined to me what was going to happen as a result of that refusal. Fortunately we were represented by a very able man of the legal profession, Mr. Killam, who subsequently became a judge and then chairman of the Railway Board.* After he got the judge calmed down to the point of listening to his story, the explanation was duly made. The Chief Justice then indicated I was dismissed, that it was no use of these complaining people coming to him, and that there would be no further writs of mandamus in this matter and that we would not be compelled to issue a diploma to any man until he had passed the necessary examination. We were able to get along under that *obiter dictum* until we got the act amended."[1]

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*Later Mr. Justice A. C. Killam and Chief Commissioner (1905-08), Board of Railway Commissioners for Canada.

After graduating from Trinity College School at Weston, Ontario, not far from the Dennis family estate "Buttonwood", Dennis had joined H. B. Smith, C.E., in 1872, at the age of 16, on an exploratory survey party in the lakes district of Manitoba. In 1873 he was head chainman for John Lestock Reid on base-line surveys in northwestern Manitoba. For the following three years he worked on the Special Survey with Lindsay Russell. In 1878 he was appointed to take charge of a survey party instructed to establish the Fourth Meridian in the North West. In the following year he joined the Canadian Pacific Railway as surveyor and engineer, and during a period of three years with the railway company Dennis surveyed and laid out town lots at Winnipeg, Prince Albert, Edmonton and also in what is now known as Kenora, Ontario.

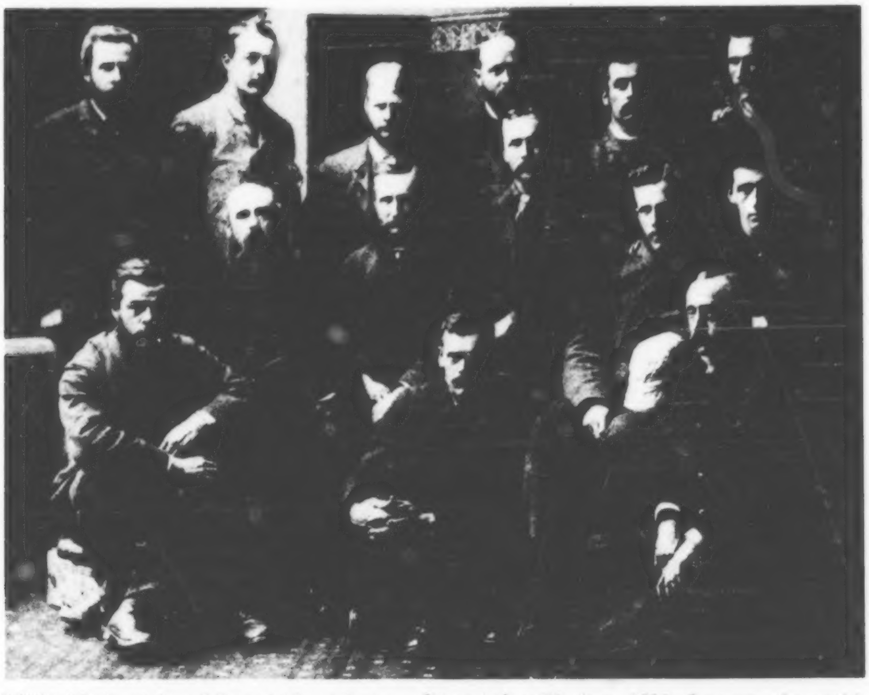

FIGURE 28. Association of Provincial Land Surveyors (Manitoba) at Winnipeg, 1882. Surveyors who participated in the meeting in Winnipeg in April, 1882, at which the Association of D.L.S. was first organized. *Standing:* (left to right) J. K. McLean, T. R. Hewson, L. R. Ord, J. F. Garden, H. C. Denny, C. E. Wolff. *Second Row:* C. F. Miles, F. W. Armstrong, Tom Kains, C. A. Magrath, H. Proudfoot. *Seated in Front:* A. F. Cotton, Thomas Drummond, Edgar Bray. *Also present at the founding meeting but not pictured:* Walter Beatty, J. Doupe, T. Fawcett, R. W. Hermon, W. F. King, Otto J. Klotz, J. J. McArthur, W. Ogilvie, E. J. Rainboth, G. C. Rainboth, J. G. Sing, A. C. Talbot, W. T. Thompson, I. Traynor.

Spring was tardy in its arrival in Manitoba in 1882. The winter had been exceptionally severe with a record snowfall of 98 inches. The spring thaw combined with heavy rains to transform the countryside into a morass. Roads and railway lines occasionally became impassable. Many Dominion land surveyors found it impossible to undertake any field work. A number of them gathered in Winnipeg to await improved conditions. It was during this period of enforced inactivity that the Association of Dominion Land Surveyors came into being. In his notable diary, kept over a period of 56 years with the lapse of only one day's entry, O. J. Klotz referred to some of the early steps in the life of the organization:[2]

"*Saturday, April 22, 1882*—In the evening a meeting is held of the Dominion Land Surveyors in the service of the government for the purpose of discussing the advisability of asking for an increase of pay. I was elected chairman, and after some discussion a committee was appointed to draft a memorial. Bray, J. Garden and A. Cotton came to my room afterwards and we had several bottles of beer.

"*Sunday, April 23, 1882*—I drew up the memorial to the Government.

"*Monday, April 24, 1882*—The men started off on the train but shortly returned on account of a washout on the road. In the evening the memorial which I drew up was laid before the meeting of surveyors who approved thereof and all signed it. Thereupon it was proposed to form an Association to further our mutual interests and to meet in Ottawa next winter. Whereupon I was unanimously elected president and A. F. Cotton, secretary-treasurer, and we immediately formed a fund for current expenses of two dollars per man."

FIGURE 29. Joseph Doupe, President, Manitoba Land Surveyors, 1906.

Official records of these initial meetings have never been found but the following is a partial list of surveyors who attended them: J. Doupe, T. Fawcett, R. W. Hermon, W. F. King, O. J. Klotz, J. J. McArthur, E. J. Rainboth, G. C. Rainboth (1846-1910), J. G. Sing, A. C. Talbot, W. T. Thompson and I. Traynor. Klotz remained as president of the Association until 1886 when Thomas Fawcett succeeded him. Cotton was secretary-treasurer until 1887 when he was followed in that office by A. O. Wheeler.

Entries in the Klotz diary for February, 1883, disclose the nature and scope of some of the Association activities in that year:

"*February 20, 1883*—Arrived in Ottawa, Stayed in Russell Hotel. D.L.S. meeting in P.M. Congratulated on address.

"*February 21, 1883*—Drafted memorial [re financial betterment of D.L.S.] to Sir John A. Macdonald. Interviewed Sir John A. at House of Commons. Sir John non-committal. Afterwards the boys got together.

"*February 22, 1883*—Called with E. Deville and W. F. King. It is well that such a gathering of D.L.S. in Ottawa occurs but once a year for it is a severe test upon one's internal area and capacity."[3]

On February 19 and 20, 1884, the Association held its first annual meeting of which proceedings were published. It was held in Ottawa and relevant entries in the diary indicate that Klotz did not always enjoy clear sailing in his bids for the Association presidency:

"*February 19, 1884*—Arrived at Ottawa. D.L.S. meeting in p.m. Exciting contest for president. The contractors wanted J. A. Snow, the first ballot was a tie 17 to 17. [Note: Klotz was elected on a further ballot.]

"*February 20, 1884*—Saw Deville who gave rather a discouraging outlook for surveyors this season. Same afternoon another meeting of the D.L.S. Association when I delivered a paper on projections . . . ".

Of 11 honorary members elected, five (Selwyn, Macoun, Bell, Dawson and Harrington) were professors. The others were Lindsay Russell, Deville, King, Andrew Russell, E. E. Taché and Bolton Magrath. On June 30, 1884, Lindsay Russell retired owing to failing health.

A highlight of the presidential address by Klotz in February, 1885, was a reference to a triangulation survey designed to cover all Canada. Such a survey, according to Klotz, was urgently required and was a responsibility of the Dominion. So impressed were his fellow members by this need that during the March, 1887, meeting a strongly worded 'memorial' to that effect was submitted to the Ottawa government urging the establishment of a Canadian geodetic survey. The need for a more ambitious hydrographic survey of Canadian waters was also pressed. Another matter that inspired serious discussion in the early day of the Dominion Land Surveyors Association was "the injustice done to Dominion Land surveyors by allowing civil engineers to sign plans of right-of-way surveys for railways in the North West Territories and [asking] that the Department refuse to accept or file any plans signed in this way." Deputy Minister Burgess of the Department of the Interior replied in March, 1888, that with regard to government railways "legal opinion indicates that the Government is under no obligation to employ Dominion Land surveyors to survey the right-of-way or to prepare the necessary plans."

Still another matter of importance to receive attention in those early days was the possible affiliation of the various provincial surveyors' associations, namely those of Quebec, Manitoba, Ontario and British Columbia with the Dominion Land Surveyors' Association. At its 1891 annual meeting President William Ogilvie of the latter organization stated, "Quebec and Manitoba, for the present at least, do not see their way to the accomplishment of the [affiliation] scheme."

At this same meeting note was taken officially of the fact that a member of the Dominion Land Surveyors' Association, Henry Irwin, assistant engineer, Canadian Pacific Railway Company, Montreal, in competition with fellow professionals from the United States and Canada, had won the first prize of $400. This contest had been sponsored by the University of Pennsylvania and was organized to obtain the best paper on road-making and maintenance.

In 1885 President Klotz, Secretary-Treasurer Cotton and the executive committee of the Dominion Land Surveyors' Association called on the Minister of the Interior to urge that the Railway Belt in British Columbia be surveyed in accordance with the Dominion Lands survey system and by Dominion Land surveyors only. In the same year, marked by the death on July 7 of Surveyor General Dennis, another committee of the Association was empowered to draft a bill to incorporate the Association. At the 1886 annual meeting President Klotz confessed that "regarding incorporation, as I anticipated, nothing effectual was done, for the Government did not look favorably upon the scheme, especially that part relating to the power of examining and granting commissions. In this respect we are placed in a far different position from Provincial Land Surveyors seeking incorporation; to the latter, undoubtedly, such rights belong and should be given." So far as can be discovered, the Dominion Lands Surveyors' Association was never incorporated.

In 1886 Dr. W. F. King and Dr. R. W. Bell acted as a committee to inquire into the best means for having a uniform system of map making in the various departments of the government at Ottawa. In 1888 standing committees of three members each were appointed to consider and report upon such topics as instruments, geodetic survey, publications, land surveying, natural history and geology, permanent marking of surveys, topographic surveying and photography as applied to topographic surveying.

In 1890, under the presidency of J. S. Dennis Jr., the Association declared that it would be of great benefit to the profession and the public if the work of Surveyor General Deville on the use of photography in surveying ('Photo-Topography' was the term used) were published. Undoubtedly this motion referred to Deville's notable book entitled ***Photographic Surveying*** of which 50 copies were lithographed and issued in 1889. This volume was published by the Government Printing Bureau, Ottawa, in an edition dated 1895. In the preface of the work Deville acknowledged the valuable assistance he had received, as author, from Klotz and King.

The first annual dinner of the Dominion Land Surveyors' Association took place in February, 1890. It was served in the dining room of the House of Commons and was attended by 44, including the following invited guests: A. M. Burgess; Professors Selwyn, Dawson and Macoun; Doctors Deville, Bell and King; also A. T. Drummond. The Association had voiced objection to the authorities in Ottawa over the fact that surveying in Indian Reserves of the Railway Belt in British Columbia had been performed by others than Dominion Lands surveyors. The 1890 meeting was advised by the Deputy Minister of Justice that all such surveys should have been made by duly qualified Dominion Lands surveyors.

The 1890s brought a decline in the fortunes of the Association. Economic depression was widespread, immigration fell off, the future for federal land survey work appeared more and more obscure and, in addition, there had been a considerable drain of members away to provincial associations. The 1894 annual meeting, held on February 19, was brief and poorly attended. The entire business of the gathering was devoted to ways and means of suspending the organization. On February 24 Secretary-Treasurer Dufresne circularized the membership, conveying advice of the decision to suspend.

In addition, as Klotz had aptly remarked in his presidential address to the Association in 1886, "we have surveyed our heads off". He added, "Block and outline surveyors [in 1883] vied with each other in doing a big season's work . . . [We] devoured . . . the whole country with instrument and chain." With obvious regret Klotz saluted 'the old days' when he commented, "The days of outfitting in Winnipeg and camping at Moose Jaw are things of the past, never to return." But when he went on to observe that "the functions of the Dominion Land surveyor are just about over . . . " he was unduly pessimistic. Actually the future held in store many good years of constructive surveying activity in the field of federal surveys.

With the advantage that always comes with hindsight it is now quite clear that a fundamental error in administration was made in starting surveys in the western interior too abruptly and with an excess of surveyors, rather than in beginning the task gradually with a relatively small number of men, then building up the total employed year by year. Under the plan actually adopted, when the program of work was restricted, good men were laid off. It would seem that there was not any well-established rule to be followed in the provision of employment in the field. From season to season, especially after 1880, the numbers of surveyors in the western interior varied considerably.

A perusal of annual reports of the Minister of the Interior discloses the short-sighted character of the government's policy and attitude on the surveying of new territories. Such surveys seem to have been regarded during the 19th century as a generally unpalatable but unavoidable factor in contributing to the peopling of western farmlands. Seldom did Ottawa authorities appear to realize the close connection between survey work and effective settlement programs. Dr. Deville remarked as late in the day as 1912, "In the past surveys were always wanted in a rush, and then when immigration fell off or general business failed, the whole thing fell down." As these conditions fluctuated the fortunes of the Dominion land surveyor rose and fell and it was not until 1907 that the Association experienced a revival of interest and a renewal of its activities.

FIGURE 30. Convention group, Dominion Land Surveyors, at Ottawa, 1912.

In its earlier days the proceedings at annual meetings could be quite exciting. In his diary entries covering the 1888 gathering Klotz referred to "objectionable remarks" on February 19 reflecting indirectly on the Government and the Interior Department, the Minister and Deputy Minister by the then Association president, E. J. Rainboth.

"*February 20*—Before attending the D.L.S. meeting in the evening I hurriedly consulted Dr. Ferguson on parliamentary rules as I was bound to have the President's address discussed and the objectionable parts repudiated. With 'blood in my eye' as Webb saw, I went to the meeting and after the presiding officer made a motion that 'the President's address be now received and open for discussion', I, as expected, was ruled out of order but there was no baffling me this night. I demanded to have the question put to the meeting whether I was out of order. The president refused to do so—Chaos reigned. I finally put the question myself and found only three dissenting voices . . . Some threatened to sever their connection with the Association on account of the arbitrary proceedings . . . In fine the President re-read his address and a vote to repudiate certain clauses carried . . . Mr. Lightfoot, a visitor, said that the proceedings of the House of Commons weren't a 'patch on this'."

Quebec

In Quebec the formation of a provincial organization of land surveyors took place soon after the appearance of such bodies in Manitoba and in the federal sphere. The first move in French Canada in the matter appears to have been made by C. E. Gauvin who wrote to Hon. E. J. Flynn, Commissioner of Crown Lands on this project early in 1881.[4] Gauvin, in this initial letter, drew attention to the fact that surveyors were becoming more numerous in the province and that they ought to form themselves into an incorporated association as in the case of other professions. By incorporation, he pointed out, desirable standards of ability, conduct and knowledge could be established and enforced. The so-called "parish surveyors", unofficial and inadequately trained land surveyors of that time, would soon disappear once incorporation was achieved. The menace of litigation would fade as increasing reliance could be made upon the accuracy of title deeds to properties. Discipline within the profession could be enforced more effectively.

Gauvin's arguments carried much force. In any event those who gave support to the idea of incorporation received official encouragement. A lawyer was retained and formal notices of filing for incorporation were duly published in the Official Gazette, the Montreal Gazette and other organs. A draft bill setting forth proposed terms was distributed. One of the sources of official encouragement of this project was Commissioner Flynn. His continuing interest in and guidance of their organizing activities in this formative period won the admiration and gratitude of Quebec surveyors.

On May 27, 1882, the Quebec Legislature passed the bill that marked the birth of the organization by incorporating the "Corporation des Arpenteurs-Géomètres de la Province de Quebec" (45 Vic. ch. 16). The Corporation has continued to function and flourish ever since that event. The first general meeting took place in the newly-erected Legislative Building on July 4, 1882, with 41 surveyors present. P. N. Dorion presided on this occasion and C. E. Gauvin acted as secretary. Fifteen surveyors were elected to the first board of directors of the Corporation, its Board of Management. These were: James Addie, Charles Baillairgé, W. A. Ashe, J. N. Gastonguay, P. P. V. Du Tremblay, P. Horace Dumais, E. T. Fletcher, C. S. Lepage, F. M. Lachaine, J. H. Leclair, J. J. McArthur, David C. Morency, Antoine-Étienne Painchaud, W. McL. Walbank and J. E. Vannier. Also at this meeting Charles Baillairgé was elected president, James Addie and Antoine-Étienne Painchaud were made vice-presidents, E. T. Fletcher was named secretary and F. M. Lachaine, syndic. At this July meeting Commissioner Flynn was formally thanked for his important assistance in obtaining incorporation and, in 1890, his advice concerning regulations of the organization won him a modest fee. At that time he appeared to be serving as a legal advisor to the Corporation.

In July, 1882, the board of management, through a small committee, drew up a code of regulations to govern the activities of members of the profession practising in the province.[5] The new rules debarred unqualified surveyors from practice in accordance with section 44 of the statute of incorporation. Gauvin was authorized to communicate with the government of Australia and the governments of the various Australian states for the purpose of obtaining authentic information on the status of the profession in that Dominion and on the management of land-survey matters in that federal system. When Fletcher was made curator of the Corporation museum in July, 1885, Gauvin succeeded him as secretary of the Corporation.

On April 10, 1889, the board decided to submit a new code of regulations to a general meeting and a year later by-laws were given approval. By this time Corporation members were deriving benefit from learned colleagues through the presentation of papers at regular meetings. W. A. Ashe, for example, addressed his fellow professionals on *Compass and*

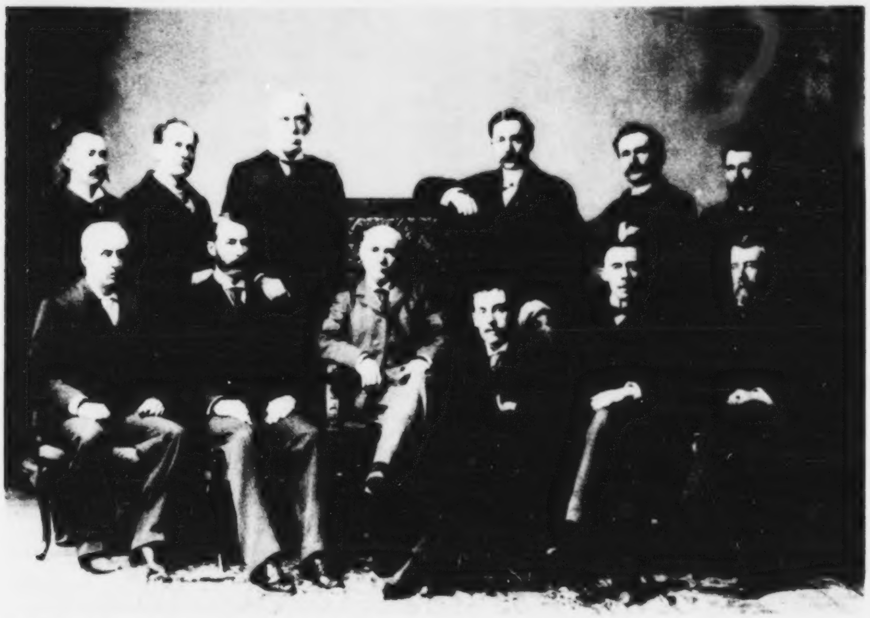

FIGURE 31. Board of Management, Corporation des Arpenteurs-Géomètres, at Quebec City, 1882. *Standing:* (left to right) H. B. Tourigny, J. N. Gastonguay, J. H. Sullivan, J. P. B. Casgrain, J. E. Sirois, J. E. Mailhot. *Seated:* P. C. Talbot, G. P. Roy, D. C. Morency, Arthur Smith, C. E. Gauvin, T. Breen.

FIGURE 32
Charles P. F. Baillairgé.

FIGURE 33
F-X. Thomas Berlinguet, surveyor of Trois Rivières still active at 96 years of age, in his profession. He was admitted to practice in 1877.

Magnetic Meridians; J. N. Gastonguay gave a paper on *Surveying and Its Origins*; and L. A. Dufresne on *Geodetic Surveys*. During the July, 1887, meeting the board of management recommended that "a Chair of Civil Engineering be created in Quebec City". Twenty years later, in March, 1907, an act of the Legislature provided for the establishment of a Chair in Land Surveying at Laval University. The first director of the School of Surveying at that institution was J. N. Gastonguay.

Long before incorporation, boards of examiners had functioned in Quebec. In 1855 the board in Lower Canada, formed to pass applicants for the title of Provincial Land Surveyor, included J. Bouchette, Andrew Russell, Adolphus Larue, Charles-F. Fournier, William Ware, Joseph Hamel, John Ostell and E. T. Fletcher (secretary). In the two following years the board remained the same except that Ware was dropped. In 1868 the board consisted of Bouchette, Larue, Fournier, Hamel, Baillairgé, Fletcher and Gauvreau, with F. W. Blaiklock as secretary.

When incorporation took place members of the board of examiners were chosen from among members of the board of management of the Corporation. On July 5, 1882, a subcommittee of the Corporation was authorized to establish a form of examination for articled students and for candidates seeking to practise surveying. The sub-committee reported that five (later amended to seven) members be appointed examiners and that they report to the board of management on the aptitudes of candidates. It was stipulated that for the current sitting of the board of examiners half of the money paid as fees by candidates be distributed among the examiners as remuneration but that no examiner should receive for himself more than five dollars per day in this regard. In the following year it was provided that should a candidate be a relative of any examiner, the latter should not act in that capacity.

In 1882 the following surveyors served as examiners: Baillairgé, Fletcher, Vannier, Lachaine, Morency, Lepage and Du Tremblay. During the following decade either five or six members of the Corporation board of management acted in that capacity. On April 8, 1890, there was an attempt to have the examiners chosen from sources outside the board of management but this proposal was defeated. In 1883 it was resolved that any member of the board of management could forward any question considered desirable, within the intent of the act governing surveys and surveyors, for submission to candidates. It is of interest to observe that in that same year Mgr. Joseph-Clovis K. Laflamme was invited to attend as an examiner in geology, mineralogy, botany and history. Mgr. Laflamme (1849-1910), at the time a lecturer in geology and mineralogy at Laval University and at the Seminary in Quebec, became Dean of the faculty of arts in 1891 and Rector of the university two years later.

Up until 1921 when Senator J. P. B. Casgrain was elected president there had been only five presidents of the organization in the 39 years of its incorporated existence. W. McL. Walbank had succeeded Painchaud in 1897 and, in turn, he was followed by J. N. Gastonguay. The latter occupied the presidency until 1912 when J. E. Sirois was elected and held office for 9 years.

Senator Joseph Phillippe Baby Casgrain (1856-1939) was a man who contributed much to the advancement of this provincial organization over a period of nearly 60 years. He brought distinction to the profession of surveying in Quebec and in all Canada. A member of one of the oldest Canadian families of French origin, Casgrain received his commission as a Quebec land surveyor in 1877. Four years later he was commissioned as a Dominion land surveyor. In addition, in the course of time, he received commissions to practise his profession in Ontario and Manitoba. Named to the Upper Chamber at Ottawa in 1900 he was made an honorary member of the Canadian Institute of Surveying in recognition of the high regard in which he was held from coast to coast as well as in tribute to his enduring accomplishments on behalf of fellow surveyors.

Gauvin occupied the office of secretary of the Corporation for 23 years and was followed by Arthur Smith in 1909, another long-term occupant of the important post.

Ontario

The formation of organizations of surveyors in Manitoba and Quebec as well as of Dominion Land surveyors spurred Ontario action in the same field. Willis Chipman of Brockville was one of the leading advocates of incorporation of an Ontario association. There had been previous but abortive efforts in this regard as early as 1878. In that year, on October 21, a letter was circularized among members of the profession in the province envisioning such an organization. Nothing seems to have developed as a result. At long last a meeting took place in the Private Bills Committee Room of the Ontario Parliament Buildings in Toronto on February 23, 1886. A total of 36 surveyors attended. The proposal to form an Ontario Association of Provincial Land Surveyors was discussed. Klotz, who had been so prominently identified with the creation of the Manitoba and Dominion bodies, was first speaker. He warmly supported the proposal to bring an Ontario association into being, but warned that if it was thought that incorporation would be the sole remedy for all the ills of surveyors, considerable disillusionment would follow. He pointed out that organization and unity were the first steps to success. Then Klotz concluded by reading a letter written by Lindsay Russell, evidently in reply to the circular letter of October 21, 1878, including the following excerpt:

"I sympathize", Russell wrote, "in all efforts to raise the standard or status of our profession but I cannot see that it is practical to do anything by legislation . . . The only legitimate means of raising the status of the profession consists in the effort of each individual thereof, by the evidences of conduct, acquirements and ability to win for himself a good opinion of those of his fellow-citizens with whom he comes into contact. The more as individuals the members of the profession succeed in this, the higher as a class they will stand . ."[6]

Thomas Fawcett of Gravenhurst thought otherwise and wrote to the meeting in his capacity of newly-elected president of the Dominion Land Surveyors' Association in this

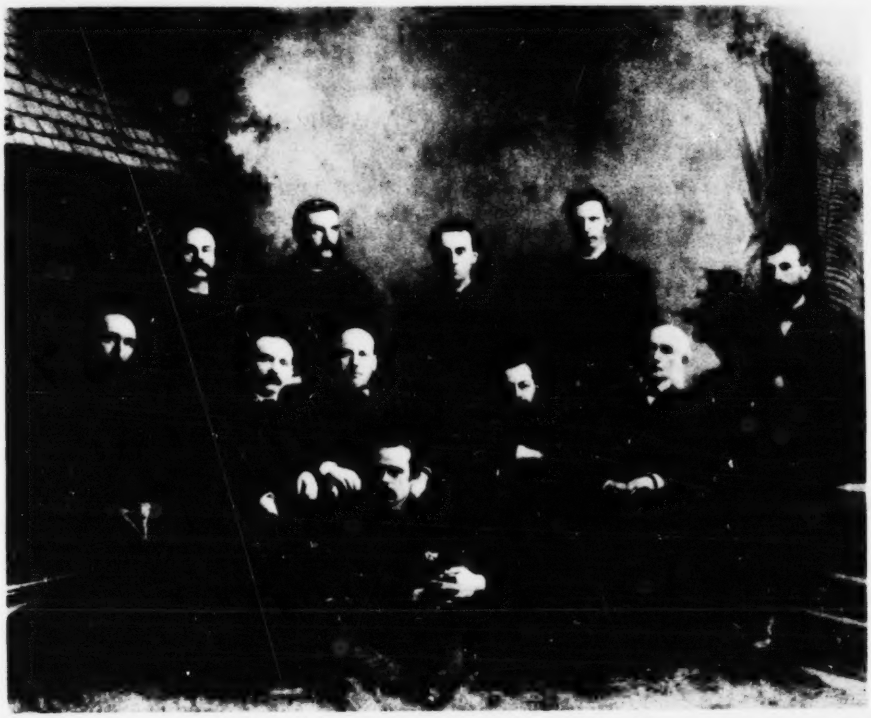

FIGURE 34. Board of Management, Corporation des Arpenteurs-Géomètres, Quebec City, 1897. *Standing:* (left to right) Ant. Painchaud, P.P.V. Du Tremblay, Mgr. Laflamme, W. McL. Walbank. *Seated:* Addie, Morency, Chs. Baillairgé, W. A. Ashe, C. S. Lepage, E. T. Fletcher, F. M. Lachaine.

wise, "Although I have not been engaged for a number of years in making surveys in the Province to any extent, yet any move to raise standards of the profession meet with my entire approval . . . In a profession concerning so wide a field as that of land surveying it's next to impossible for any one person to become an expert in all its branches; through the medium of papers prepared by different persons . . . facilities would be offered for gaining information . . . and all members of the profession would be benefitted by attending meetings."

Alexander Niven, P.L.S. (1836-1911) of Haliburton also thought it desirable to form an association and pointed out that the Surveyors Act of the province required amendments.

(Probably Niven had reference to the 1849 Act—12 Vic., ch. 35—and subsequent amendments including those of 1851 and 1855.) "To the very clever surveyor", Niven pointed out, "we would say that you will undoubtedly become a 'crank' unless you occasionally rub up against your professional brethren and get 'corners' polished off. To the 'rusty' brother we think there is probably no better way of brightening you up than by forming the new Association."

P. S. Gibson, P.L.S. of Willowdale, who had been named chairman of the meeting (with Willis Chipman as secretary), had indicated that such an organization might well suggest to the board of examiners lists of subjects on which candidates could be examined, including amendments to any existing lists. A committee of three was appointed to draft a constitution and by-laws, consisting of Klotz, Chipman and Gibson. The meeting, in all, occupied three days, February 23 to 25 inclusive. This is regarded as the first annual gathering of Ontario surveyors. George B. Kilpatrick, P.L.S., of the Crown Lands Department, Toronto, was named first president of the organization, John Galbraith, vice-president and Willis Chipman, secretary-treasurer. The executive committee consisted of Peter Silas, P. S. Gibson, Alex. Niven, William Ogilvie, Charles Unwin, A. C. Webb, G. B. Abre, T. C. Keefer, Thomas Fawcett, D.T.S., O. J. Klotz, D.T.S., J. McAree, D.T.S., Villiers Sankey, P.L.S., and A. J. Van Nostrand, P.L.S.

At the fourth annual meeting of the Association of Provincial Land Surveyors held, according to circular No. 19, in the Canadian Institute, 46 Richmond Street East, Toronto, February 26 to 28, 1889, the officers for 1888-89 were Niven as president, Sankey as vice-president and Chipman as secretary-treasurer. Councillors included John McAree, H. B. Proudfoot, W. R. Aylsworth, P.L.S. (Deseronto). There were standing committees on legislation, publication and instruments. Papers dealt with such widely varied topics as "City Surveys", "Timber Exploring" and "Railway Right of Way Surveys". In 1892, the Association requested the Ontario government to pass a bill incorporating the Association of Ontario Land Surveyors and this was done that same year.*

By its continuing efforts the Association in those early years of its existence did much to elevate the status of surveyors generally and to correct conditions such as those exemplified in the advertisement in an Ontario newspaper in 1864 that announced "Mr. Blank, P.L.S., Conveyancer and Issuer of Marriage Licenses. In returning thanks to his numerous friends begs leave to remind all in Kent and Essex that he is always on hand in the above line of business—all orders either verbal or written promptly attended to . . . Can boast over all for cheapness and can adjust all difficult lines with the aid of old field notes of Samuel Smith, Esq. No extra charge for travelling, as he keeps a conveyance of his own. Charge: $4.00 a day. Silver at par for issuing marriage licenses."

Alberta

Although Alberta had been carved out of the westernmost part of the Territories lying south of the 60th parallel, it was not until the spring of 1910 that a meeting of surveyors took place in Edmonton, the provincial capital, designed to bring about the formation of a provincial land surveyors' association. That initial gathering was closely linked in time with the passage of chapter 21—The Alberta Land Surveyors' Act—of the Alberta statutes, on March 19, 1910. The first regular annual meeting of the organization thus incorporated was held on January 17, 1911, also in Edmonton and was attended by 20 surveyors. R. W. Cautley, then surveyor to the Land Titles Office, Edmonton, acted as chairman. He was elected secretary-treasurer and registrar of the new body. William Pearce became first president of the organization and Lionel Clare Charlesworth its first vice-president. Mr.

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*The organization, under this name, regards 1892 as the year of its founding.

Pearce was a well-known western surveyor and a former inspector of Dominion lands. In 1875 he had been appointed to the original Dominion Land Surveyors Board of Examiners. He was particularly noted for his pioneering work in land settlement and irrigation.

The first council of the association consisted of J. L. Coté, M.L.A., A. P. Patrick, D.T.S., R. H. Knight, Maurice Kimpe, B. F. Mitchell and A. J. Latornell. All of these men, with possibly one exception, were both provincial (Alberta) land surveyors and Dominion land surveyors.[7] For the next two years Charlesworth served as association president. A. P. Patrick was vice-president. The membership at this time totalled 85. Charlesworth was succeeded by R. W. Cautley whose brother, R. H. Cautley, replaced him as secretary-treasurer and registrar. Subsequent presidents of the association, up to 1920, were A. C. Talbot, J. L. Coté, H. H. Moore, A. S. Weekes and P. N. Johnson. First elected to the Alberta legislature in 1909, Hon. Jean Leon Coté (1867-1924) had a distinguished career in public life. He became Provincial Secretary in 1918 in the cabinet headed by Premier A. L. Sifton. Named a senator for Alberta in 1923, he died little more than a year later. Charlesworth became Alberta's first Director of Surveys in September, 1905, and Deputy Minister of Public Works, serving from October 15, 1915, to March 21, 1921.

At the 1911 meeting the first item of business on the agenda was a discussion of the admissibility of Dominion land surveyors to membership in the Alberta association. It would appear that a certain amount of professional friction continued to exist between these two classes of surveyors and the unhappy controversy over the membership status of the Dominion land surveyors in relation to the provincial organization is reflected in the following extracts from the 1911 minutes:

"Mr. Cautley was able to inform the meeting that the Deputy Attorney-General, after consultation with the Hon. Mr. Mitchell [Attorney General], had definitely decided that any Dominion Land Surveyor resident in the Province on the 16th of December, 1910, was entitled to be registered under subsection 25 (1) of the Act.

"Mr. Cautley also read an adverse recommendation made by the Hon. Mr. Aylesworth, Minister of Justice, on complaint of the Surveyor General of Canada and communicated to the Lieutenant-Governor of Alberta, with a view to demanding that the Act be changed or that it be vetoed."[8]

Special references were made in the early official proceedings of the association to the deaths of two illustrious pioneer Alberta land surveyors, namely Robert Watt Lendrum, D.L.S., who died in 1912, and Archibald W. Ponton, D.L.S., who died in 1915.

British Columbia

The roots of the surveying profession in British Columbia reach deeply into the early history of that province. Government supervision of land surveys exerted a constant influence on survey activities in British Columbia from the time of the appointment of Joseph Gaspard Pemberton as Colonial Surveyor of Vancouver Island Colony in 1851. In the formation of the first organization of British Columbia surveyors Dominion land surveyors played a prominent part, men of the calibre of W. S. Gore, A. F. Cotton, Tom Kains and E. B. Hermon.[9] In the list of authorized land surveyors published in the British Columbia Gazette dated January, 1891, out of a total of 82, 23 were Dominion land surveyors.

Prior to 1890 some 140 men constituted the group of unorganized land surveyors in the province, including two who had risen to the post of Lieutenant Governor of British Columbia, Sir Joseph W. Trutch and Hon. Edgar Dewdney. But the need to come together in a professional association was being widely felt. A preliminary meeting of seven land surveyors took place in New Westminster on October 16, 1890. Out of this gathering of W. S. Jemmett, J. A. Kirk, A. F. Cotton, J. McKenzie, A. J. Hill, C. E. Woods and N. B. Gauvreau came the initial proposal to form a provincial organization of surveyors. Members of the profession in various parts of British Columbia were canvassed to ascertain their views on the idea. As a result, a meeting of 22 surveyors took place in City Hall, Victoria, on December 1, 1890. The Surveyor General, W. S. Gore, was in the chair. On this occasion, which lasted two days, The Association of Provincial Land Surveyors was duly launched. In a form of primary election, the results of which were made subject to confirmation at the first regular annual meeting of the embryo body, Edward Mohun was nominated for the presidency, T. S. Gore (brother of W. S. Gore) was named vice-president, and Tom Kains, secretary-treasurer. An executive committee of three was set up, consisting of J. A. Kirk, E. B. Hermon and E. A. Wilmot. An interesting but rather optimistic motion was passed at the final session of this gathering to the effect that "the proceedings of the meeting be kept as secret as possible until after the annual meeting."[10] Also at this meeting it was decided to petition the provincial government asking "for the introduction of an act to protect authorized surveyors in the performance of their duties, to prevent unqualified persons acting as surveyors and to provide for duly qualified persons from time to time being admitted to practice."

The once-postponed annual meeting occurred on April 27, 1891. The initial choices, in the main, were confirmed. But there were a few alterations. J. A. Kirk was substituted for T. S. Gore in the post of vice-president. Mr. Gore, however, was made a member of the executive committee consisting of E. B. Hermon, R. Hyland and himself. E. A. Wilmot, who became vice-president of the association in 1892, was dropped from the pioneer executive committee. Incidentally, J. A. Kirk was named association president in 1892 and served a two-year term. Tom Kains served as Surveyor General of the province from 1892 to 1898 inclusive, to be succeeded by W. S. Gore, serving a second term.

A significant motion passed at this April, 1891, meeting was addressed to the Chief Commissioner of Lands and Works, and to every land surveyor in the province. It declared that "it is the opinion of The Association of Provincial Land Surveyors that a P.L.S., when entrusted with a survey, is at liberty to employ competent assistants to perform the work *under his direct supervision* but the surveyor must in his own proper person satisfy himself *on the ground* that the work is correctly done and that a surveyor would not be justified in certifying to surveys made by any other person." (Author's italics.) Attempts to enforce this reasonable requirement were to be attended by troublesome repercussions.

On April 20, 1891, an Act respecting Land Surveyors (chapter 17) became law. Undoubtedly this measure was passed by the provincial legislature in response to pressure exerted by surveyors who had become increasingly conscious of the importance of their functions in the life of the growing province. As a consequence of the 1891 Act, land surveyors in British Columbia became known as Provincial land surveyors with the right to add "P.L.S." after their names. It was not until the passing of a measure in 1905 that the letters "B.C.L.S." came to supersede the former letters of entitlement. Up to the time of the 1891 Act the issue of authority to practise surveying was vested in the Chief Commissioner of Lands and Works for British Columbia and with the Surveyor General of the province. In the biography of a pioneer civil engineer in British Columbia (C. H. Busk, L.S.), who arrived in Victoria in 1883, the following passage occurs:

"I established myself in a couple of rooms on Yates Street until I could work around and learn something of the country and opportunities in my profession. As a preliminary I called on Sir Joseph Trutch and the Surveyor General [W. S. Gore] and from both I learned that as I owned a theodolite and level and allied instruments it was to be presumed I knew how to use them, and accordingly no examination or licence was necessary—all I had to do was to get the offer of some work and then go and do it."[11]

The 1891 Act endowed a board of examiners with disciplinary powers over practising members of the profession. A schedule of fees payable by surveyors to the provincial treasury was established. No provision was made, however, for incorporation of an association of provincial surveyors. Subjects for consideration at the 1892 annual meeting included the questions: "Should the period of apprenticeship be lengthened?" and "Are surveyors paid for the work they do in proportion to the pay received by members of other professions for professional services?". The 1891 meeting had appointed a committee to formulate a tariff of rates and a schedule of prices for surveys in the province and in April, 1893 a schedule of minimum fees and charges was adopted for Vancouver Island. This included the provision of ten dollars per day of not more than ten hours! The minimum rate for work in timber limits was $30 per mile. For surveys of city lots: for one lot, $15, for 2 lots adjoining, $20. For the preparation of original plans and field notes, $10 per day; for a description of metes and bounds, $10.

The failure to obtain incorporation and the resulting absence of complete autonomy by surveyors in their own affairs brought about a gradual decline in interest in the work of the organization. From 1899 to 1905 there are no existing records of any association meetings or elections. Incorporation finally was achieved when chapter 7, An Act respecting Provincial Land Surveyors became law on April 8, 1905.

Following Mohun and Kirk the association presidents up to and including 1898 were E. B. Hermon, H. B. Smith, J. F. Garden, A. F. Farwell and F. C. Gamble. Ernest Bolton Hermon and James Ford Garden were Dominion land surveyors.

Saskatchewan

At the opening session of the first legislature of Saskatchewan an Act respecting Public Works (chapter 10) was given royal assent on May 26, 1906. This measure re-enacted sections 27 to 30 inclusive of the 1901 Public Works Ordinance already mentioned in this chapter. Incidentally, section 2 of the latter legislation had defined terms such as "surveyor", "district surveyor" and "engineer". Chapter 24, 1906, "The Land Titles Act" established the Torrens system of land titles in the province. Certain sections of this legislation provided for survey plans of roads and Indian lands among other subjects.

The history of the Saskatchewan Land Surveyors' Association may be said to have developed in three principal stages. The first stage ended with incorporation of the association in 1913. The completion of the second stage was marked by the affiliation of the profession with the University of Saskatchewan, authorized by chapter 50 of the provincial statutes of 1923. The third stage is still in progress. Curiously enough the initial talks concerning the formation of an association of land surveyors in Saskatchewan took place in Alberta. Early in 1906, in Edmonton, several Dominion land surveyors met and discussed the possibility of creating such an organization. Among those present was F. J. Robinson, at the time Deputy Commissioner of Public Works in Saskatchewan. Some at the meeting voiced hopes that a professional organization could be brought into being embracing all three provinces of Canada's western interior.

Following this informal exchange of views Robinson, in somewhat humorous vein, wrote to his friend, J. Lonsdale Doupe of Winnipeg, " . . . since Manitoba was mentioned I see no reason why they [Manitoba surveyors] should not be consulted and, if agreeable, I think a good association could be formed in the three prairie provinces. I understand, however, that the Manitoba surveyors are very conservative and very select and may object to any action that would make possible the over-running of their postage stamp* with a lot of promiscuous surveyors who hitherto have been precluded from their presence."

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*Manitoba's original shape was that of a relatively small square.

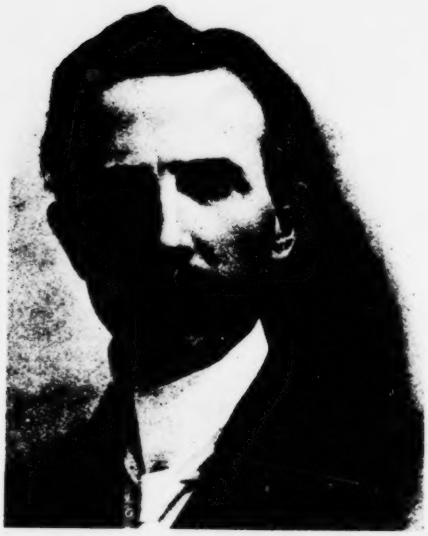

FIGURE 35
J. Lonsdale Doupe, President,
Manitoba Land Surveyors, 1912-13.

Many surveyors resident in the western interior were sympathetic to the formation of a prairie-wide association but inability to formulate a workable constitution, acceptable to all concerned, led to the abandonment of this ambitious concept. But the special need for organizations of surveyors in each of the two newly-formed western provinces could not be long neglected if high professional standards were to be maintained. "I consider that the registration of sub-division plans", Robinson wrote to a fellow surveyor in Edmonton in 1906, "should be protected in order that everyone who can squint through a transit will not be entitled to file plans in the Land Titles Office."

At a meeting of district surveyors of the Saskatchewan Department of Public Works in Regina on May 27, 1909, the question of forming an organization of provincial surveyors was discussed and a committee of four named to deal with the matter. This committee consisted of A. J. McPherson, H. S. Carpenter, E. H. Phillips and E. W. Walker.[12] Some three months later all Dominion land surveyors active in Saskatchewan, totalling 21, were circularized by the committee. The letter drew attention to the necessity for such an organization and referred to certain desirable legislative goals. In the meantime a draft bill, prepared by A. J. McPherson, seeking to establish proper controls for the profession in the province, had been submitted to the government of Saskatchewan and on December 18, the last day of the 1909 session of the legislature, The Land Surveyors' Act, based on the McPherson draft, was passed. The measure became chapter 13 of the provincial statutes of that year. By this enactment a new creature was born and clothed with statutory legality, namely, the Saskatchewan land surveyor. However, he was without any rights of self-government in the internal affairs of his profession. All authority to enforce disciplinary measures was vested in a board of examiners appointed by the Lieut.-Governor-in-Council. This first board consisted of F. J. Robinson, A. J. McPherson and E. J. Phillips. Secretary to the board was H. S. Carpenter. The board's first meeting was held in Regina on December 31, 1909.

In 1910 the district surveyors met again and considered the report on the committee appointed in the previous year. On the basis of that report it was decided to seek the incorporation of an association, particularly for the purpose of obtaining for the profession itself, some degree of autonomy. The 1910 meeting was held in the office of the District Surveyor in Regina and was attended by A. J. McPherson, H. S. Carpenter (elected to the chair), W. W. Meadows, E. H. Phillips, W. R. Reilly, J. D. Shepley, W. M. Stewart, Cyrus Carroll, W. T. Thompson, C. W. Clarke, M. B. Weekes (secretary of the meeting), E. W. Walker and A. C. Garner. A motion 'that an Association of Saskatchewan Land Surveyors be formed' was passed. The first president of this voluntary, rather than officially incorporated, organization was J. L. R. Parsons; W. R. Reilly was elected vice-president and an executive committee of three was appointed, A. C. Garner, H. K. Moberly and M. B. Weekes. The latter served also as secretary-treasurer of the embryo organization.

On December 19, 1913, a new Saskatchewan Land Surveyors' Act was passed (chapter 24), replacing the 1909 legislation. Under this statute the incorporation of the Saskatchewan Land Surveyors' Association was formally achieved. The powers granted to the organization were related, in the main, to the disciplining of members, control of examinations leading to a surveyor's commission and the right to practise in Saskatchewan. Provision was made for a board of examiners appointed by the executive council of the association. On December 26, 1913, this council met and appointed E. H. Phillips (chairman), R. H. Montgomery and M. B. Weekes as a board of examiners, supplanting the 1909 board. These men served continuously until 1923. The council also by motion, requested the provincial Minister of Public Works to deposit with the Association all records of the former board of examiners. Some 26 years later this request was met, somewhat indirectly, through a decision of the then Director of Surveys of the province, Weekes, to dispose of certain old, out-dated documents.

These developments in Saskatchewan were duly noted by fellow surveyors in Manitoba. In his 1914 presidential address to the Association of Manitoba Land Surveyors J. Lonsdale Doupe remarked that "congratulations to our sister association of Saskatchewan are in order, their act of incorporation having received legislative sanction on the 19th of last month, particularly as they have paid us the compliment of framing their act largely on the same lines as our own . . . as the control of examinations for commissions is now vested in the Saskatchewan association, instead of in a board appointed by the government, as formerly."[13]

In March, 1914, A. C. Garner was elected president but in November of that year enlisted for military service overseas. His place as association president was taken by W. A. Begg.

The emergence of North America from a period of economic depression in the closing years of the 19th century resulted in a definite upswing of public interest in the settlement of Western Canada and in a resumption of large-scale subdivision surveys in the western interior. In turn these burgeoning developments brought in train a marked revival of the Association of Dominion Land Surveyors. The initial meeting of the reorganized surveyors occurred in Ottawa in 1907, the first such gathering since 1894.

As the new provinces of the West achieved momentum in growth it became increasingly evident that the control of the natural resources of these western areas, including ownership of public lands, would pass in time from the Dominion government to the governments of the provinces. Consequently the fear grew among Dominion land surveyors that they would be eliminated from survey work on lands so transferred. They felt that all too soon their commissions would be restricted, in effect, to the Yukon and Northwest Territories, Indian reserves and national parks. The attitude of the newly-formed provincial associations of surveyors did little to allay their fears.

Some Dominion land surveyors held strong views on the supremacy of their commissions vis-a-vis any provincial commissions. For example when R. W. Cautley, on behalf of the infant Alberta Land Surveyors' Association, wrote in June, 1911, to P. R. A. Belanger, the Dominion land surveyor, he received in the following month an indignant reply to the offer that Belanger be accepted, on payment of regular annual dues, for registration as an Alberta land surveyor:

"Being a director of the Dominion Land Surveyors' Association, a great number of whose members have been denied the right of membership in your Association, according to your Act of Incorporation, and having personally unsuccessfully applied for redress, I consider it would be derogatory to the position I occupy as Vice-President of the D.L.S. Association to accept for my personal interest a privilege that is denied to so many of my fellow brethren in the profession. Under the circumstances I have no other alternative than to decline the offer made to me."[14]

Deville endeavoured to sound a note of reason in the rising clamor:

"Dominion land surveyors . . . had been put out of private business in the western provinces by the legislatures. That was, perhaps, unfair but they had to put up with it, for the provinces were within their rights."

Thomas Fawcett, in his presidential address in 1912 to the Dominion Land Surveyors' Association, sagely pointed out:

" . . . we might draw the inference [from the trend to eliminate the Dominion land surveyors as such from doing provincial surveys] that after being a Dominion land surveyor it would be wise policy on the part of any young man to pass also the additional examination or examinations required to become a Provincial land surveyor for the province in which he expects to reside . . . and the sooner he does this . . . the easier he will find it. A man who passes the Dominion Land Surveyors' Board of Examiners can pass the board of any of the provinces in all the subjects which are covered by both examinations." This would have been the sane approach in the involved situation that had developed. After all, as Fawcett tried to explain, compliance with the requirements of the provinces would be little more than a formality. Yet even the mere acknowledgment of this rather routine obligation was apparently regarded by the more sensitive Dominion land surveyors as an affront to their professional dignity and status.

Garner, writing from Regina on February 20, 1912, to the annual meeting of the Association of Dominion Land Surveyors in Ottawa, added some fuel to the fires of debate by submitting a questionnaire for convention discussion, including a query on the attitude to be adopted by the Association concerning the absence of any provincial government rule or directive that only Dominion land surveyors could perform legal surveys on public lands in those provinces.[15] There does not appear to have been any official record made of the position taken by the Association executive on Garner's questionnaire. Not for many years to come would the feelings of distrust and bitterness engendered by this jurisdictional dispute dwindle and finally disappear.

Board of Examiners

Ottawa's decision to resume land surveys in Manitoba as a prelude to the re-opening of the western interior to settlement brought about an increase in the number of applicants for commissions as Deputy Surveyors of Dominion lands, as they were initially known. This increase demanded the establishment of an examining and admitting body. Accordingly, under section 74 of the 1872 Dominion Lands Act the appointment of a federal board of examiners was authorized. It was provided that the board consist of the Surveyor General and eight other competent persons to be appointed by Order in Council. Oaths of office were to be administered by a judge. The board would appoint its secretary. This method of appointing a board secretary was followed until 1951 when, under section 5 of the Canada Lands Survey Act, it was provided that the secretary be appointed by the Minister of Mines and Technical Surveys for Canada. In 1899 the act was amended, reducing the membership of the board from 9 to 3 persons, namely, the Surveyor General and two Dominion topographical surveyors. But at the outset the board, as established by Order in Council dated May 7, 1875, consisted of Surveyor General Dennis as chairman, Assistant Surveyor General Lindsay Russell, Andrew Russell, A. C. Webb, A. H. Whitcher, Milner Hart, William Pearce, Bolton Magrath and Pierre N. Dorion.

The first meeting of the board was held in Winnipeg in June, 1875, mainly because so many surveyors were in the field in Manitoba at that time. But considerable difficulty was experienced in obtaining a quorum of board members. The meeting was postponed several times from May 27 to June 10 when at last a bare quorum assembled. Present were Lindsay Russell as chairman along with A. H. Whitcher, Inspector of Surveys, and William Pearce. The meeting was held in the Dominion Lands Office.[16]

Seven candidates appeared at this historic first meeting of the board. Two of these, Frank McPhillips and L. S. Vaughan, withdrew during the examination stage. Commissions were granted to William Crawford and G. M. Kingston, P.L.S., both of Ontario and to George McPhillips, John Francis and Robert Bourne, all from Manitoba. Under provisions of the 1872 act, candidates had to be at least 21 years of age and were required to pass examinations in Euclid (first six books), Plane Trigonometry, Mensuration of Superficies, Plotting and Map Drawing, Spherical Trigonometry, Astronomy, Geology, the keeping of field notes, the performance of practical surveying operations and use of instruments. Nor would a commission be granted unless the applicant "shall be perfectly conversant with the system of survey as embodied in the Dominion Lands Act" and with the manual of instructions and regulations issued at Ottawa for the guidance of Deputy Surveyors of Dominion lands.

No person was entitled to be examined for a Dominion land surveyor's commission unless he had served three successive years under articles as a pupil of a Deputy Surveyor. The only exceptions to this rule included qualified Provincial land surveyors, who were not required to serve any period in articles before taking the examinations; university or college graduates, who were required to serve one year only in articles and, finally, any qualified surveyors from the British dominions other than Canada who were required to serve only six months in practice with a Deputy Surveyor before writing the examinations.

It is greatly to the credit of Surveyor General Dennis that he was so acutely aware of the magnitude and basic importance of the surveying task in the West, and of the technical factors involved, that he strongly urged upon the Minister of the Interior the desirability of inviting surveyors who held Dominion land surveyors' commissions to subject themselves to more exacting tests of their knowledge and abilities. The Surveyor General recommended that such tests be even more probing and extensive than those normally imposed in regard to subjects specified in the 1872 legislation. Accordingly examinations for Dominion topographical surveyor (D.T.S.) came into being and the award of this relatively rare title was made following a showing satisfactory to the board of examiners. During the entire period, 1876 to 1965, only 32 have qualified for this distinction.

In 1877 the following received Dominion topographical surveyors' commissions: E. Deville, J. S. Dennis, Jr., T. Fawcett, O. J. Klotz, W. A. Ashe, A. P. Patrick, John Galbraith and W. T. Thompson. The year previously W. F. King had received his Dominion topographical surveyor's commission, the first of these awards. All of these men were required to first pass examinations for their Dominion land surveyors' commissions. Up until 1951 Dominion topographical surveyors were commissioned as qualified for performing extensive topographic surveys or geographic explorations. After passage of the Canada Lands Survey Act, certificates only, rather than commissions, were issued to testify to the possession of knowledge of the higher branches of surveying.

Sidney F. Austin, a federal government employee in Winnipeg, acted as secretary pro tem of the board of examiners. He was followed by Robert Lang, who served from 1875 to 1884. During Lang's period there were two men who acted as temporary secretaries, C. D. Rickards in 1878 and again in 1882; also T. Fawcett in 1883. P. B. Symes was board secretary from 1884 to 1906 with G. W. Paterson substituting on a pro tem basis for him in 1885. F. D. Henderson served as secretary to the board from 1906 to 1914.

The first person to be commissioned as a Dominion land surveyor after due examination before the board was William Crawford of Milverton, Ontario. Commission number one is dated June 17, 1875. It must be borne in mind, however, that under the 1872 legislation, Provincial land surveyors were entitled to be "blanketted in" as Deputy Surveyors of Dominion lands without first taking formal examinations.* By 1875 all such surveyors became Dominion land surveyors.

The first session of the board of examiners extended over seven days. Under section 85 of the 1872 act each board member was entitled to receive five dollars for each day's sittings as well as actual travel and living expenses. In the years to follow, board meetings took place in Ottawa although there were some early exceptions to this custom. For example, board meetings took place in Winnipeg in June, 1875 and June, 1878; in Victoria in May, 1885; and in Toronto in May, 1903.

At the second meeting of the board, held in Ottawa and beginning on November 13, 1876, Surveyor General Dennis was in the chair with Lindsay Russell and Andrew Russell also in attendance. It was at this meeting that King received both his Dominion land surveyor's and Dominion topographical surveyor's commissions. Thomas Fawcett and A. G. Cavana withdrew from the Dominion topographical surveyor's examination but both were awarded their Dominion land surveyors' commissions.

By an amendment in 1899 the board membership was reduced to three, including the Surveyor General (Deville) and two Dominion topographical surveyors (King and Klotz). Even with the reduction in board membership quorum difficulties continued to be encountered. In 1903 a meeting had to be held in the absence of King in England on Alaska Boundary business, and of Klotz in Australia on longitude determination. In order to provide a quorum John Galbraith, D.T.S., of Toronto, was appointed by Order in Council of April 6, 1903, to temporarily fill the place of any board member unable to attend a meeting.

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*Existing records indicate that at least 436 Provincial land surveyors availed themselves of this opportunity.

ASSOCIATION OF DOMINION LAND SURVEYORS

Past Presidents

1882	Otto J. Klotz
1883	Otto J. Klotz
1884	Otto J. Klotz
1885	Otto J. Klotz
1886	Thomas Fawcett
1887	Thomas Fawcett
1888	E. J. Rainboth
1889	J. S. Dennis
1890	William Ogilvie

1891	J. S. Dennis
1892	John McLatchie
1893	John McLatchie

1907	E. W. Hubbell
1908	E. W. Hubbell
1909	R. E. Young
1910	R. E. Young
1911	Thomas Fawcett
1912	P. R. A. Belanger
1913	C. F. Miles
1914	C. F. Aylsworth
1915	A. H. Hawkins
1916	A. H. Hawkins
1917	J. J. McArthur
1918	J. N. Wallace

Secretary-Treasurers

1882 to 1886	A. F. Cotton
1887 to 1890	A. O. Wheeler
1891	J. I. Dufresne
1892	S. Bray
1893	J. I. Dufresne
1907 and 1908	T. S. Nash
1909 and 1910	E. W. Hubbell
1911 and 1912	E. M. Dennis
1913 to 1918	E. W. Hubbell

5

SURVEYS OF THE FIRST TRANSCONTINENTAL ROUTE AND ITS RAILWAY LANDS IN THE WEST

In negotiations leading to the creation of Manitoba the retention of public lands of the new province "for the purposes of the Dominion" was regarded by both Sir John A. Macdonald and Sir Georges E. Cartier as one of the most significant aspects of the terms of union. This provision, however, was not without its price. Part of the true cost of this arrangement can be found in the provision that ungranted lands, to the extent of 1,400,000 acres, were to be set aside for the benefit of the families of half-breed residents. Nevertheless federal control of the public lands was a prominent factor in the negotiations, about a decade later, for the building of an all-Canadian transcontinental railway line. The relative isolation from central Canada in which the first Riel troubles flourished demonstrated the wisdom of undertaking this ambitious project at the earliest possible time.

The government of that day felt it necessary, in view of the serious financial risks involved in constructing a line across hundreds of miles of thinly-populated territory, to give outright to the railway-building company blocks of land tributary to trackage. These properties could be held for unearned increment or sold by the company and resulting revenues applied against construction and operating costs.

In his 1870 recommendations to Ottawa Archibald made a trenchant and farseeing observation on the probable need for land grants to railway companies in aid of line construction:

"In computing the area at the disposal of the Crown I have not made allowance for any tracts which should be laid aside for railway subvention. Yet it will be necessary not to lose sight of this important service. Alternate townships or alternate lots on the line of the transcontinental railway and on the line of a junction between it and the railway system of Minnesota will probably be required for the encouragement of the companies by whom these enterprises may be prosecuted."[1]

The rectangular system of land surveys and the device of granting land subsidies to new rail companies were practices borrowed by Canada from the United States. As in the case of the pattern of surveys so it was in the matter of these land grants. The basic concept in each case was modified in certain important respects in order to make it more applicable to Canadian conditions.

Curiously, when the concept of the land subsidy in aid of railway building was formally introduced in Canada by the "Act respecting the Canadian Pacific Railway" (35 Vic. ch. 71) of June 14, 1872, such subsidies had been largely discredited and virtually discarded in the United States.* The practice had spread corruption in politics and instability in the realm of public finance in that country. It is not likely, however, that the action of the government of Canada was taken either in defiance or in ignorance of the American experience. Rather it would appear that in the light of circumstances prevailing in Canada at the time, not much choice remained to the government in the matter. "If we could get the railway and keep our public lands", observed the Manitoba Free Press on May 24, 1873, "we would prefer such a course, but that is impracticable."

In 1862, in the midst of the Civil War, Congress had chartered the Union Pacific Company to build across the American West. In 1853 Congress instructed the Secretary of War to have surveys made for a transcontinental railroad. But the question whether government or private enterprise was to build the line remained open. Delays resulted from the absence of any general agreement on this point of high policy. But as early as 1852 Commissioner Butterfield of the General Land Office recommended to Congress that land grants be made in aid of construction of a transcontinental railroad. Congress, in 1862, passed the Transcontinental Railroad Land Grant Act. Under this legislation nearly 19 million acres of public land were granted to the Union Pacific Railroad Company. The Northern Pacific and other rail lines were to receive even larger grants. President Lincoln decided that the east and west terminals of the transcontinental road would be Omaha and Sacramento respectively. On January 8, 1863, just seven days after the Declaration of Emancipation, the first shovelfull of earth was turned at Sacramento by the Central Pacific. Nearly a year later the Union Pacific commenced construction at Omaha. The two lines met at Promontory Point, Utah, and on May 10, 1869, a golden spike ceremony took place to mark the epoch-making event. Americans were properly jubilant over this magnificent achievement which was to be matched, if not surpassed, by Canadians sixteen years later when they staged their own final spike ceremony at Craigellachie, British Columbia.

Though the policy of land subsidies undoubtedly helped to get railways built in the United States, the administration of the policy resulted in a train of grievances. The grants of large acreages aroused hostility among settlers who feared the creation of giant monopolies. In addition there was an inflexibility in the American pattern of land grants to railroads that resulted in social tensions. Finally public revulsion over the practice led to its abandonment but not before nearly 150 million acres of United States public lands had been alienated in this way. In Canada, while the policy remained in force, about 32 million acres were transferred from the public domain to railway firms in aid of line construction.

In the American West, railways and settlers advanced together. In the Canadian West the railway company soon became a colonizing agent of great importance. Developments over the years, particularly in regard to the Canadian Pacific Railway Company, demonstrated that, on the whole, the land subsidy system was justified on the grounds of national interest. It served to bring together a group of dynamic men who completed a transcontinental railway in five years instead of the expected ten, and it made the rail company an agency of land settlement second only to the Dominion government. Its vigorous encouragement of immigration and land occupation far outweighed the dollars and the acres the railway company received in subsidies.[2]

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*The last land grant made to a U.S. railroad was in January, 1873.

Improvements to farm machinery also helped to stimulate the flow of settlers to the Canadian West. Mechanical grain elevators that revolutionized methods of storing and grading cereals not only speeded up the settlement process but helped railway business immeasurably. These advances, along with the timely discovery of early-maturing Red Fife wheat added to the pace of progress.

There is considerable evidence that public statements by Professor John Macoun (1831-1920), probably Canada's greatest botanist-explorer, did much to attract people, as well as the Canadian Pacific main line, to the more southern and low-precipitation areas of the western interior. Macoun who, in the 1880s became Assistant Director and Naturalist with the Geological Survey of Canada, was criticized for deliberately popularizing the more southerly region of the Prairie West. In his own writings Macoun acknowledges the fact that such complaints were being made.[3] Consciously or otherwise Macoun, with others, was instrumental in transferring enthusiasm for the country through which the original Canadian Pacific Railway surveys led, to those parts of the interior which, to some extent, had been described by Palliser as "a central arid desert".[4]

In addition a new policy of land disposal was desperately required if the West was to be speedily opened up for development. Huge acreages had been transferred to single ownership. Under the terms of the 1872 Dominion Lands Act the Hudson's Bay Company received section 8 in each township and section 26 in each township whose number was divisible by 5, along with the south half and northwest quarter of section 26 in all other townships.*

After abortive federal government efforts in 1872 and 1878 an agreement for the construction of a transcontinental railway in Canada was made with a small group, mainly Montrealers, led by George Stephen, a financial wizard, and William Cornelius Van Horne, an American railway builder and administrator of great ability, drive and resourcefulness. In consideration for the promise to construct, equip, maintain and operate such railway the government, by sections 9 and 11 of the agreement concluded on October 21, 1880, and ratified by Parliament in February 1881, agreed to grant to the company a cash subsidy of $25,000,000 and a subsidy in the form of land amounting to 25,000,000 acres. This land grant was to consist of alternate sections carrying uneven numbers and consisting of 640 acres each. These grants extended to a width of 24 miles on each side of the main rail line from Winnipeg to the Rockies. By far the largest proportion of these grants came from the territories now contained within the boundaries of Alberta and Saskatchewan.

At this point in the terms of the agreement a conditional phrase was inserted, the far-reaching implications of which apparently escaped the grasp of the contracting parties at the time. The condition was that should any of the land so granted consist in a material degree of land "not fairly fit for settlement" the company should not be obliged to accept same as part of such grant. Any deficiency so created was to be made up from other portions (to be selected by the company) in the tract known as the fertile belt, that is, land between the 49th and 57th parallels of latitude. Such grants were to be areas including alternate sections extending back 24 miles on each side of any branch line or lines of railway and these lands were to be shown on a map or plan to be deposited with the Minister of Railways at Ottawa.

Although the terms of this agreement might, at first, appear overgenerous and were in fact severely criticized on this ground in Parliament at the time, it is altogether possible that a company any less endowed could not have avoided insolvency in seeking to carry to a conclusion such a highly expensive project. Nevertheless, to an extent not originally contemplated, vast acreages in western areas were alienated from government control. Of the 25,000,000 acres promised to the Canadian Pacific Railway Company (less about 7,000,000 acres returned by the company to the federal government in satisfaction of an emergency loan from Ottawa) only 5,255,870 acres were found, after surveys along the main line, to be "fairly fit for settlement" in the opinion of the railway company. Accordingly more than 12,000,000 acres had to be found elsewhere in the western interior in order to fulfil the total federal commitment. Nearly 9,000,000 additional acres were provided in two northern reserves and a southern reserve along with Lake Dauphin lands in Manitoba. Even so, the total thus available fell short of the 1881 obligation by 3,300,986 acres.[5] It was not until 1903, by Order in Council No. 1434, August 22, that the federal commitment in this respect was completely discharged. All these land transactions were dependent upon accurate surveys and reliable reports of surveyors.

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*35 Vic. ch. 23, sec. 17.

It is quite impossible to pay adequate tribute to the remarkable endurance and solid accomplishments of pioneer railway surveyors. The task of locating the main line of the Canadian Pacific Railway between the Ottawa Valley and Red River was arduous in the extreme. It was a job undertaken in country largely unknown to civilized man and never traversed by him. The rugged land consisted of rock formations, uncounted lakes, unbridged streams and heavy forests cluttered with areas of formidable windfall. A wilderness of swamp and muskeg, insect pests, fierce summer heat and bitter cold all combined to test to the utmost the stamina and resourcefulness of the individual surveyor.

Occasionally there were periods of compensation in this otherwise arduous life. After days of tramping through thick underbrush, wading in swamps, climbing hills or fording rivers, there were long evenings in front of camp fires when good-natured banter, laughter and song supplemented the consolations of pipe tobacco and memories of home. In the words of one nostalgic, if somewhat amateur poet among them:

"The shades of night were falling fast
When 'long the C.P. railway passed
Four wanderers with a forward stoop
Thinking of friends at home—and soup."[6]

Rail route surveying consisted of five main divisions of activity. The first stage was that of general reconnaissance, followed by a preliminary phase involving the narrowing of various possibilities to a few alternatives—the fascinating task of selecting the particular from the general. The third stage was even more detailed in nature. This stage included the location surveys to determine, once a definite choice of route was made, the position of the right-of-way and a definition of the land needed for this purpose. Construction surveys constituted a fourth phase in the course of which the findings of the location survey were applied, and marks provided on the ground to guide line construction.

In 1871 a reconnaissance of the country west of the Great Lakes was made at the instigation of the federal government in order to explore the possibilities of building a railway to the Pacific Ocean. These surveys were made under the direction of Sandford Fleming as chief engineer in charge of a staff of surveyors and engineers. During a six-year period they traversed the country in various directions in search of the most promising route for a transcontinental line. In all they scouted an area 2,700 miles by 500 miles, extending over 54 degrees of longitude and 10 degrees of latitude. This comprised an area larger than France, Belgium, Holland, Germany and European Russia combined. Fleming was left to his own resources, the government being content to urge upon him all possible speed in completing his task.

Fleming laid down several basic principles to govern his reconnaissance staff in their activities:

1. Every effort should be exerted to discover a line through the wooded region (Ottawa Valley to Red River) and thus the shortest and best possible rail link between central Canada and Manitoba.
2. That line, when discovered, should reach Lake Superior by a spur line or otherwise and so provide the most economic outlet for products of the prairies through the navigable St. Lawrence River system.
3. Exploration of the Rocky Mountains should be designed to discover the most practicable line through the mountains and leading to the most advantageous Pacific port.
4. The line across the western interior was to avoid formidable river crossings and also afford access to large tracts of land available for settlement.[7]

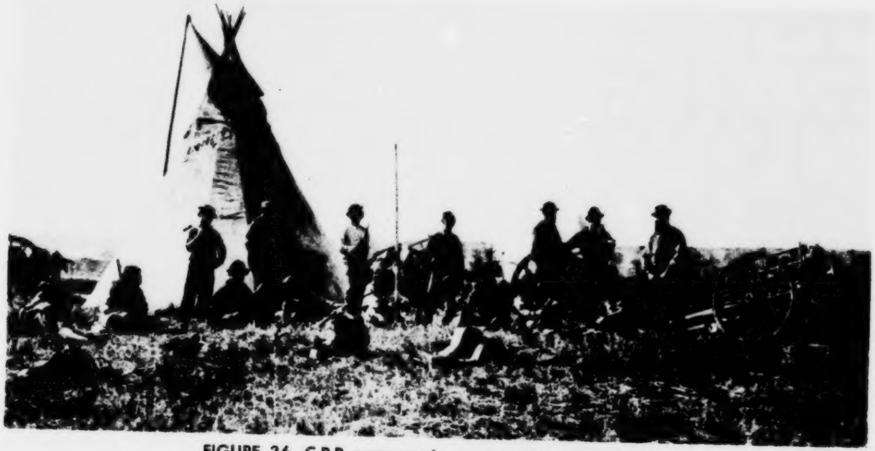

FIGURE 36. C.P.R. surveyors in camp on the western plains.

As circumstances dictated, railway surveys under Fleming varied in nature and chronological order but included explorations, exploratory surveys, revised surveys, trial locations, location surveys and revised locations. For explorations or preliminary examinations in advance of regular surveys the barometer was used to ascertain altitudes. Horizontal distances were computed on the basis of time elapsed in passing from one place to another. In some instances distances were "measured by the micrometer" or, in 20th century terminology, by the vertical angulation method. In contrast to the Gunter's chain of 66 feet used by cadastral surveyors, railway surveyors used a 100-foot chain.*

On instrumental surveys the chain, transit and theodolite, compass and spirit level were used. In densely wooded sections these surveys might consist of a series of straight lines connected by angles. These lines would be cut through tree growth and underbrush in order to obtain both horizontal and vertical measurements as a basis for future operations. Revised surveys would be made to avoid difficulties initially discovered and to shorten distances wherever possible to prepare for location work. Trial locations would involve staking

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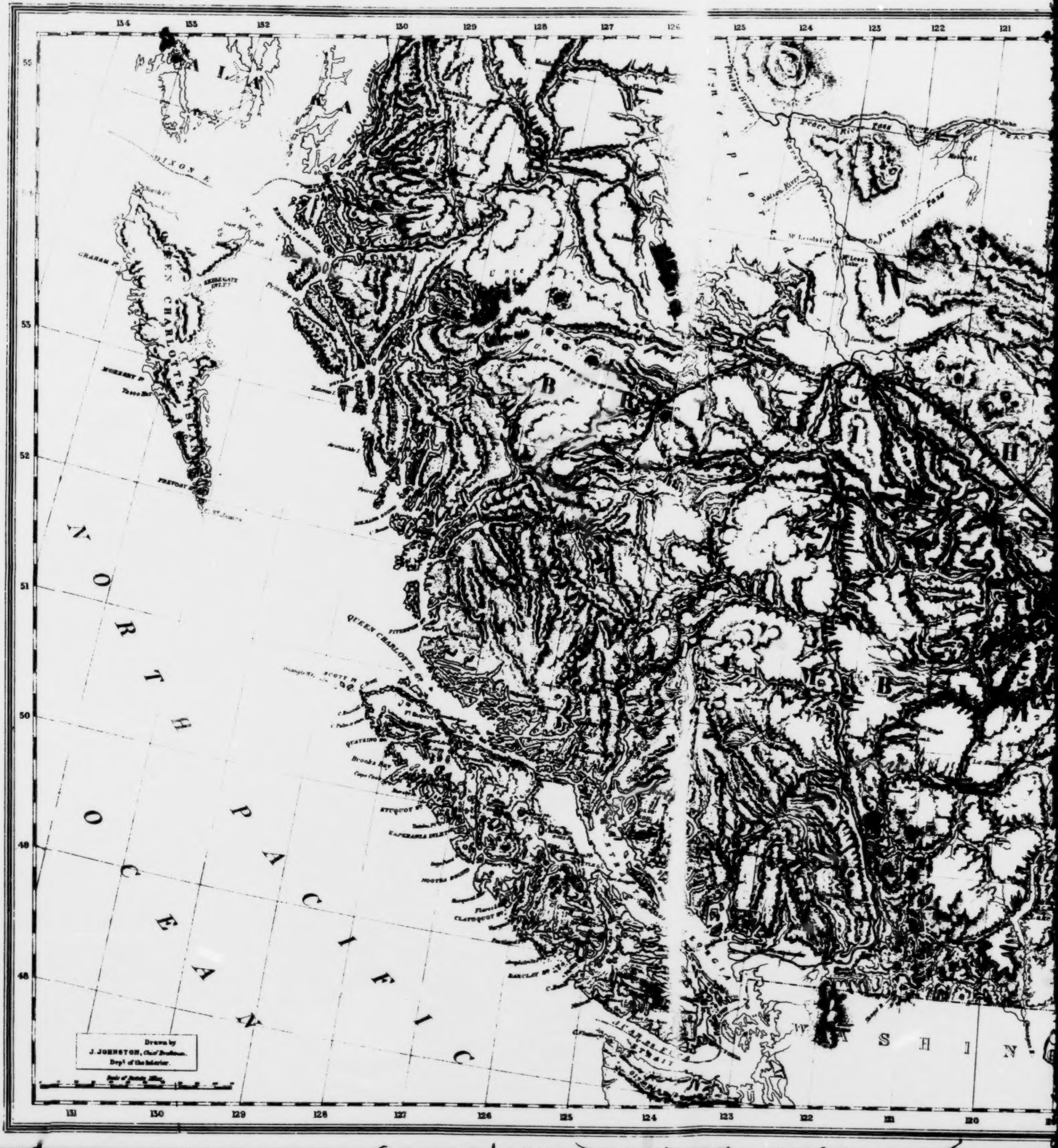
*S. Bray, *Survey of Railway Lines* Ann. Rept. 1891, Assoc. of D.L.S., p. 65.


NORTH PACIFIC OCEAN
QUEEN CHARLOTTE ISLANDS
DIXON ENTRANCE
QUEEN CHARLOTTE SOUND
BRITISH COLUMBIA
Peace River Pass
Pine River Pass
Nation River
Parsnip River
Mc Leods Fort
Mc Leods Lake
Brooks Bay
Cape Cook
ESPERANZA INLET
NOOTKA SD.
CLAYOQUOT SD.
BARCLAY SD.
JUAN DE FUCA STRAIT
WASHINGTON
Drawn by
J. JOHNSTON, Chief Draftsman.
Dept of the Interior.
134
133
132
130
129
128
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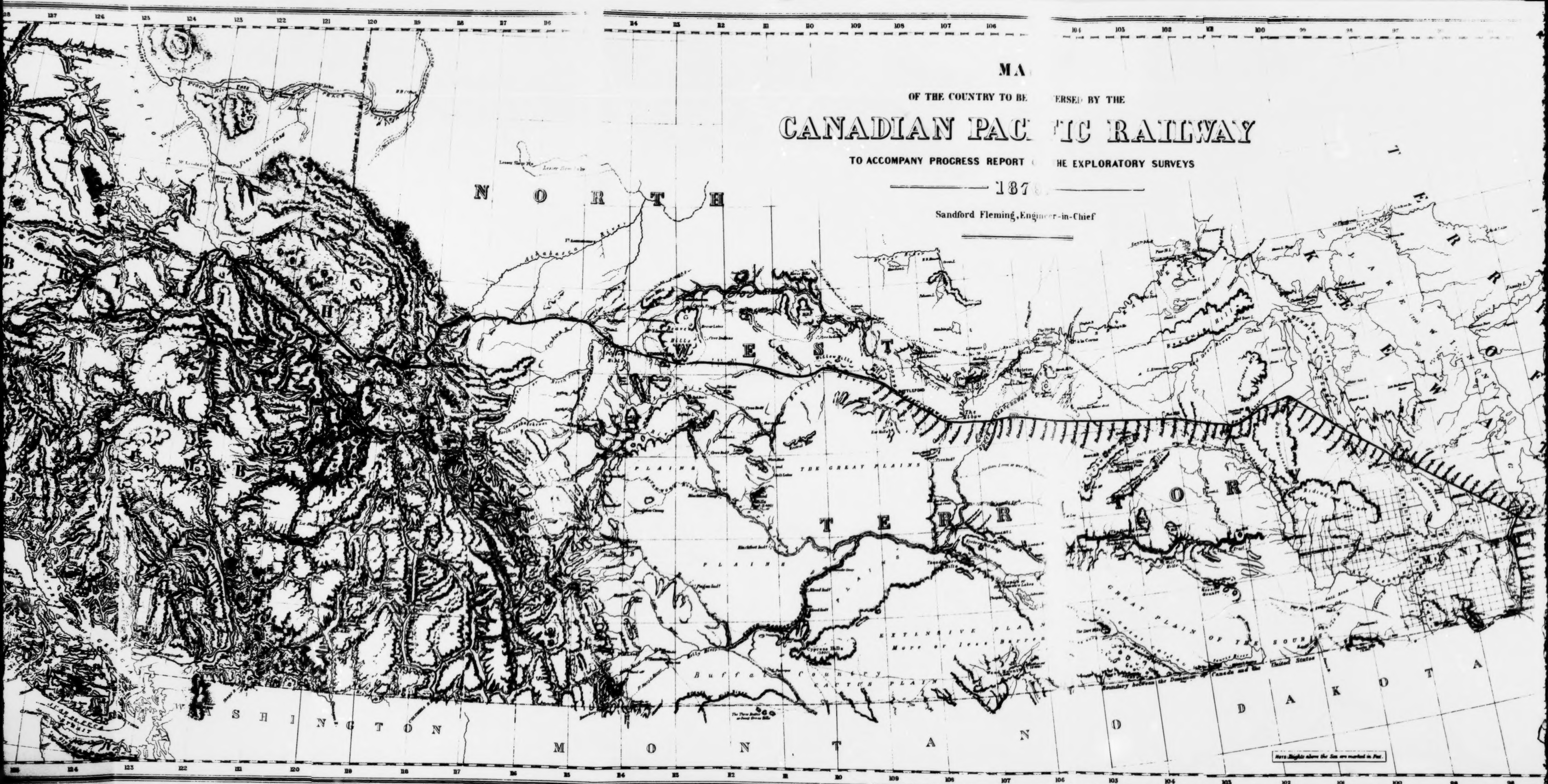

MA

OF THE COUNTRY TO BE ERSED BY THE

CANADIAN PAC IC RAILWAY

TO ACCOMPANY PROGRESS REPORT HE EXPLORATORY SURVEYS

187

Sandford Fleming, Engineer-in-Chief

N O R T H
W E S T
T E R R I T O R Y
THE GREAT PLAINS
PLAINS
EXTENSIVE PLAINS
More or less
Buffalo Country
CACTUS PLAIN
GREAT PLAIN OF THE SOURIS
Boundary between the Dominion of Canada and the United States
Athabasca River
Peace River Pass
Pine River Pass
Cypress Hills
W A S H I N G T O N
M O N T A N A
D A K O T A
Note. Heights above the Sea are marked in Feet.
127
126
125
124
123
122
121
120
119
118
117
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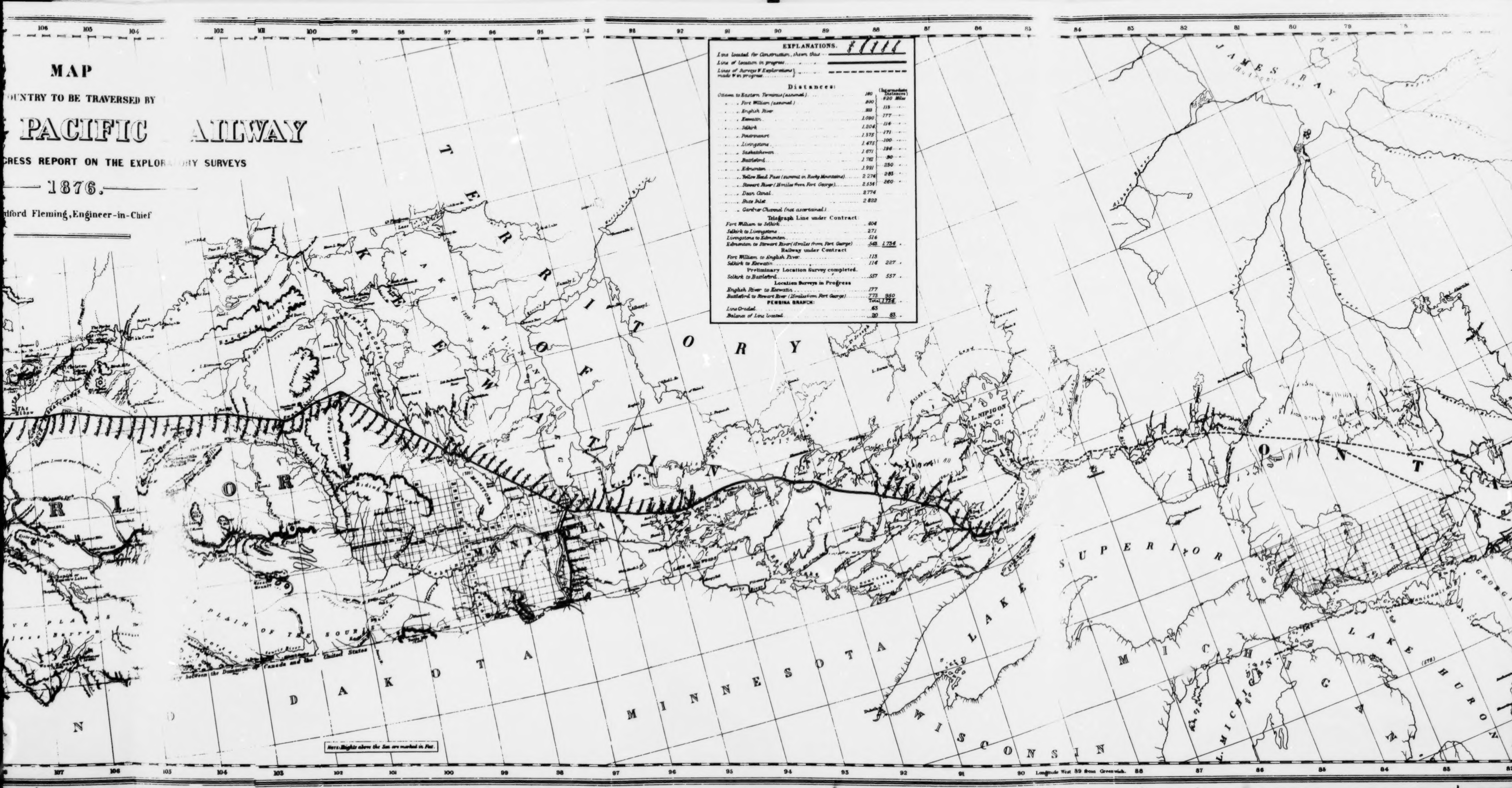
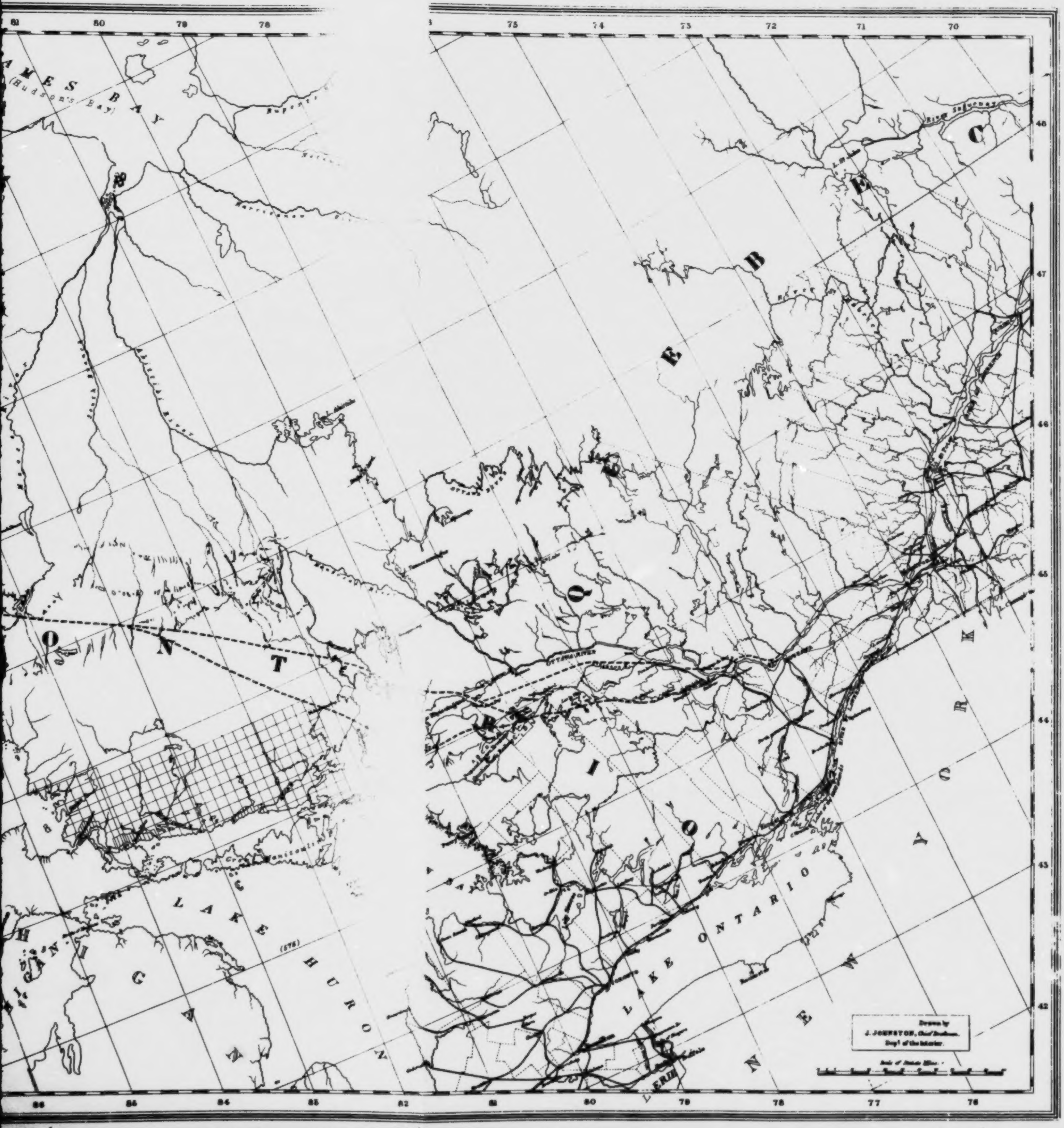

MAP
OUNTRY TO BE TRAVERSED BY
PACIFIC AILWAY
CRESS REPORT ON THE EXPLORA ORY SURVEYS
1876.
dford Fleming, Engineer-in-Chief
EXPLANATIONS.
Line located for Construction, shewn thus
Line of location in progress
Lines of Surveys & Explorations made & in progress
Distances:
(Intermediate Distances)
Ottawa to Eastern Terminus (assumed) 180 620 Miles
Fort William (assumed) 800 115
English River 915 177
Keewatin 1.090 114
Selkirk 1.204 171
Pourmount 1.375 100
Livingstone 1.475 196
Saskatchewan 1.671 90
Battleford 1.761 230
Edmonton 1.991 285
Yellow Head Pass (summit in Rocky Mountains) 2.276 260
Stewart River (15 miles from Fort George) 2.536
Dean Canal 2.774
Bute Inlet 2.822
Gardner Channel (not ascertained)
Telegraph Line under Contract:
Fort William to Selkirk 404
Selkirk to Livingstone 271
Livingstone to Edmonton 516
Edmonton to Stewart River (15 miles from Fort George) 543 1.734
Railway under Contract
Fort William to English River 113
Selkirk to Keewatin 114 227
Preliminary Location Survey completed.
Selkirk to Battleford 557 557
Location Surveys in Progress
English River to Keewatin 177
Battleford to Stewart River (15 miles from Fort George) 773 950
Total 1.734
PEMBINA BRANCH:
Line Graded 63
Balance of Line located 20 83
T E R R I T O R Y
K E E W A T I N
O F
O N T A
JAMES BAY
L. NIPIGON
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
GEORGIAN
MICHIGAN
WISCONSIN
MINNESOTA
DAKOTA
MANITOBA
R I O R
PLAIN OF THE SOURIS
Note: Heights above the Sea are marked in Feet.
Longitude West 89 from Greenwich
107 106 105 104 103 102 101 100 99 98 97 96 95 94 93 92 91 90 89 88 87 86 85 84 83 82 81 80 79 78


JAMES BAY
(Hudson's Bay)
Rupert's R.
Harricanaw R.
South Branch
Abitibi River
River Saguenay
QUEBEC
ONTARIO
Ottawa River
LAKE HURON
MICHIGAN
LAKE ONTARIO
NEW YORK
ERIE
(578)
Drawn by
J. JOHNSTON, Chief Draftsman,
Dep't of the Interior.
Scale of Statute Miles.
81
80
79
78
75
74
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77
76

out the line for construction, the tangents (straight lines of track) being laid down and, when required, curves set out. First location surveys were rarely fully satisfactory and it was only after re-surveys had been made that the revision constituted the location survey proper. In broken, hilly country where additional examinations and alterations were required, the term "revised location survey" would be employed.

In his 1877 progress report on surveys to Prime Minister Alexander Mackenzie, the frontispiece map of which (showing the country to be traversed by the Canadian Pacific Railway) was drawn by J. Johnson of the Dominion Lands Office, Ottawa, Sandford Fleming stated, "It was found that the valley of the North Thompson would, in all probability, admit of a line being built from Yellowhead Pass to Kamloops, a distance of 255 miles with grades not exceeding 50 feet per mile. . . ."[8] Further, it was found possible to reach the Pacific coast from Kamloops by the "course and outlet of Rivers Thompson and Fraser, the line terminating in an excellent harbour on Burrard Inlet."

Fleming in this report commented also that for 1,300 consecutive miles there was no altitude so low on the railway between San Francisco and New York City as the highest summit of the line through Yellowhead Pass and that such a Canadian line as he proposed would be 633 miles less than from San Francisco to New York City.

In January 1875, a survey party despatched by Fleming eastward from Fort George travelled 900 miles by snowshoe, suffering unusual hardships. For 20 days the temperature averaged 39 degrees below zero, the minimum registered during that period being 53 below zero. Many of the dogs perished and dog teams were completely disabled. By the time the party reached Fort Edmonton many of the men were suffering from cramps and dysentery. A member of the group recorded, in an official report, the emotions of the weary surveyors on the concluding stage of their epochal journey:

"Passing Portage la Prairie on May 19th we reached Winnipeg on the 21st, having been five and a half months on the [entire] trip. At White Horse Plains we met a gay cavalcade going westward. It consisted of Mr. McLeod and his two survey parties just starting for Edmonton and the Rocky Mountains, and their shining shoes, glittering spurs and well-groomed horses contrasted with our battered and weather-worn appearance. But we could afford to suffer by comparison. They would soon be as ragged as we were, and all their troubles were before them while we were just reaching the goal over many a weary mile of mountain and plain, and could take our well-earned repose in the happy consciousness of having fulfilled the task allotted to us and earned the approbation of him we are proud to acknowledge our Chief."[9]

Surveys of the entire route of the proposed main line, conducted with energy and relentless determination, had involved the loss of 34 lives and an expenditure of $3,136,000 before these necessary preliminary tasks were completed.

In British Columbia survey developments during the immediate post-Confederation period (1867-85) were primarily concerned with finding a route for Canadian Pacific tracks through the mountains to tidewater. As soon as preliminary agreement on terms of union with Canada was forthcoming in July 1870, preparation for surveys of possible routes proceeded apace. Marcus Smith was Sandford Fleming's deputy for the British Columbia section of the reconnaissance. Survey operations began in earnest in 1871 and were soon under way in various regions under eminent engineers and surveyors.[10]

Smith, in a report of activities in the Homathko Valley of British Columbia, gives a graphic account of how a typical problem in field transportation was solved. ". . . we commenced to construct," he related, "an Indian fly bridge but as we had only one axe left and but little spare rope, we had to make lashings from the inner bark of cedar, so that it took seven hours to complete the bridge which looked like a fishing rod and line hanging over the torrent, the butt end resting on the ground and loaded with boulders. We managed to crawl over this and drop down safely on the other side of the stream. Six hours more of a hard struggle among tangled creepers, over huge trunks of fallen trees and masses of detached rocks brought us to the camp of Division X. This party had completed 18 miles of trial location. I remained with them two days, examined their plans and profiles which showed the line to be generally satisfactory and a great improvement on the preliminary survey of 1872."[11]

One of the most able of the reconnaissance surveyors was Walter Moberly (1832-1915), a civil engineer, explorer and author who had arrived in the coast province from Toronto in 1859. Moberly had performed surveys for Col. Moody along English Bay, Burrard Inlet and near Port Moody. After a period of partnership with E. Dewdney on road location and construction, Moberly became Assistant Surveyor General of British Columbia in 1864 (Mainland Colony). By his subsequent surveys he helped to a considerable extent in the unfolding of the map of progress in his adopted province.

"I prospered for some time," Moberly wrote in a volume of reminiscences of his 1871 surveys, "until I received a telegram from Ottawa informing me that the Canadian Pacific Railway was to be commenced and requesting me to leave for Ottawa at once. . . . There I met my old friend of early days, Mr. Sanford [sic] Fleming and Sir John A. Macdonald [at that time Premier of Canada] and gave them full information as to the feasibility of a line for a railway through that country, and which is the one now adopted."[12]

Moberly and Fleming probably first met during the period prior to 1858 when both worked with the Ontario, Simcoe and Huron (later Northern) Railway. Moberly was employed on construction. By 1857 Fleming had become chief engineer on the project. Now both were engaged in the pioneer task of selecting the most feasible route for a transcontinental line through the mountains of British Columbia.

Soon Moberly was active in the field. "Here we formed our depot, intending it to be the main depot on the Columbia River for the surveys I proposed making through the Howse and Kicking Horse Passes; along the valley of the Columbia River, around the 'Big Bend' from Kicking Horse and Eagle Pass and across the Selkirk range by the valley of the Illecille-waet River and its southeasterly branch, which latter and proposed part I should make after the completion of the Eagle Pass survey. On October 2 I gave orders to open a trail and make a preliminary survey through the Howse Pass, and set the party at this work.

"I now returned and met the party a short distance from the valley of the Blaeberry River. . . . The weather was now colder and it began to snow. I found the levels taken by me with a very good aneroid barometer corrected with a 'boiling thermometer' both of which were of the very best make, corresponding closely with those taken by the leveller of the party; one making the difference in height, from a common point on the Columbia River, to another on the 'Flat' 1,607 feet, and the other 1,610 feet.

"I now felt quite certain that the railway would be built through the country I had examined and every possible provision was made by me to complete the exploratory surveys and follow with the location ones."

In addition to Marcus Smith and Walter Moberly the name of Henry John Cambie (1836-1928) ranks high among pioneer railway surveyors. In 1958 The Engineering Institute of Canada placed a polished steel plaque in the terminal passenger station of the Canadian Pacific Railway in Vancouver, bearing Cambie's name and commemorating his explorations and surveys in British Columbia as well as his supervision of Canadian Pacific Railway construction through the Fraser River canyons from 1880 to 1884.

Across the four western provinces the finally-determined route of the Canadian Pacific Railway in part followed, and in part deviated from, that which Fleming and his staff had

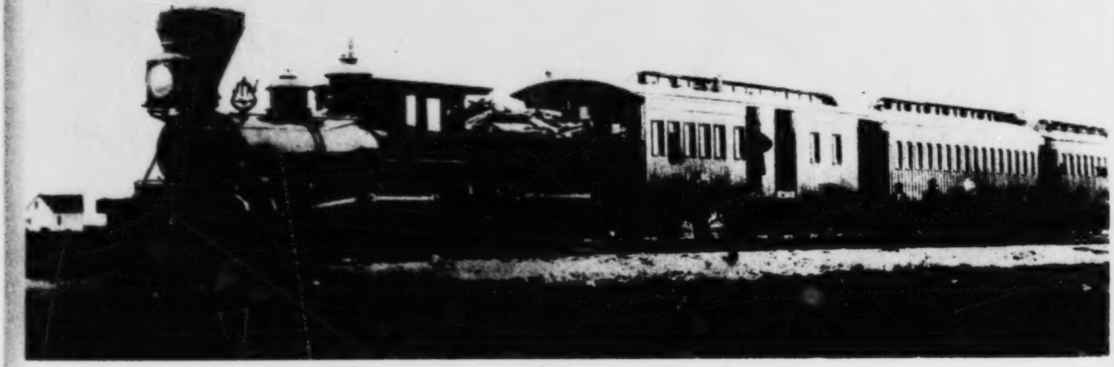

FIGURE 37. One of the first C.P.R. trains to operate on the prairies.

recommended. That a differing line was ultimately chosen does not, in any sense, reflect upon the investigations or judgment of Fleming and his colleagues. In fact that choice was governed by a variety of factors not necessarily concerned with surveying or engineering considerations. In the Ontario section, from Lake Nipissing to Manitoba's eastern boundary, the line followed Fleming's advice and hugged the north shoreline of Lake Superior in spectacular sweeps around wide bays, rather than using the height of land farther to the north. The science of logistics may have dictated this decision. It provided the opportunity for much cheaper transportation of construction supplies to the railway building site by the Great Lakes water route. Westward from Lake Winnipeg Fleming had projected a route that would cross the "Fertile Belt" of the western interior, reaching the Pacific by way of Yellowhead Pass.

Fleming, in his report of the exploratory surveys of the 1870s stated, "It is difficult to convey an accurate impression of the magnitude of the work executed, which has every year employed the best energies of not far short of one thousand men of all grades. The length of the various lines surveyed and explored aggregate to close on 46,000 miles, of which no less than 11,500 miles have been laboriously measured, yard by yard, through mountains, prairies and forests, with the spirit level, chain and transit. Much of the work has been carried on amidst the severities of winter, frequently in an exceedingly low temperature. The surveying parties were far removed from all habitations and were supplied with but inadequate shelter and diet, although both were the best that circumstances would admit of."

Fleming's skilful examination of the topography of the route he recommended confirmed the favorable opinions of earlier explorers and travellers in the Canadian West concerning the fertility and general promise of the lands that would be served by such a railway.[13] But when the transcontinental project was entrusted to the Canadian Pacific syndicate in 1880 it was announced, to the astonishment of many, that the main line would cross the prairies some 200 miles to the south of Battleford and Edmonton. The newly-chosen route through the western interior did not, in fact, stray very far from the 50th parallel of latitude except between Medicine Hat and Calgary, at which latter point it reached the 51st parallel.

The original survey of the Canadian Pacific crossed the Red River at Selkirk rather than at Winnipeg. This prospect aroused the greatest indignation in Winnipeg and the syndicate was persuaded to bring the main line directly into the capital of the province.[14]

Considerable mystery continues to shroud the reason or reasons for the syndicate's decision to depart from Fleming's expert and well-considered advice, including his report upon the favorable gradients available through the Yellowhead route. Various theories have been advanced. The alleged relative nearness of the Northern Pacific to the international boundary with the consequent threat of United States intervention in Canadian railway territory; the optimistic Macoun reports on the agricultural resources and possibilities of the southern prairies; and the desirability of the shortest, most direct route from Winnipeg to Pacific tidewater irrespective of gradients en route, all are factors mentioned by historians dealing with this puzzle. It is quite likely that each of these considerations played a part in bringing about the final determination on the direction of the main line. But a more plausible reason is that real estate developments in connection with completely new or relatively new railway townsites offered greater opportunities for profit-making by the railway company than did communities more or less well-established at that time. It was in the best fiscal interests of the railway to avoid, so far as possible, places where land would need to be purchased by the company as compared to places in which properties would have to be bought from the railway's land department.[15]

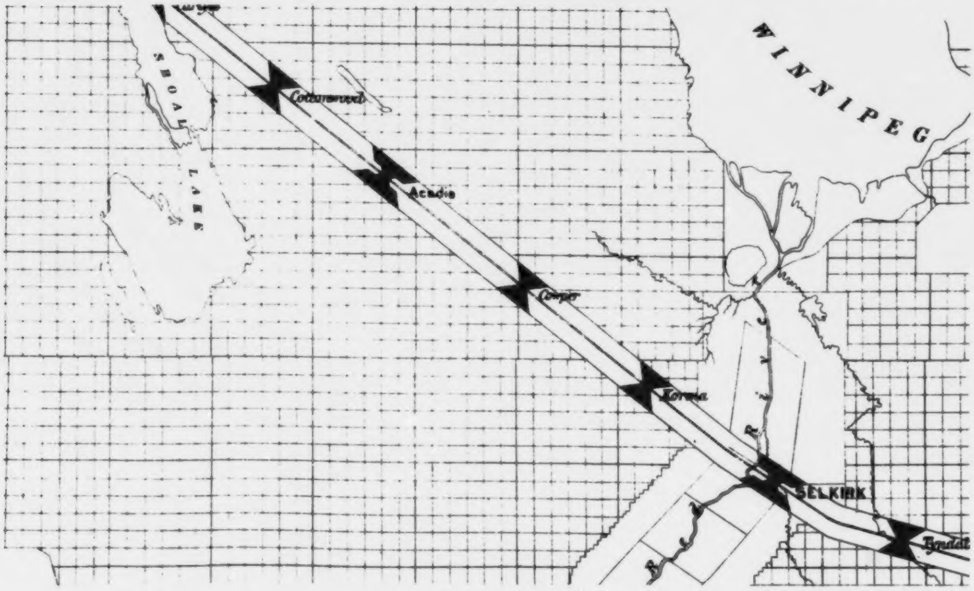

FIGURE 38. Plan of town plots, showing reservations for railway purposes as mentioned in the C.P.R. report on surveys, 1877. (Sandford Fleming)

In all, some 800 villages and towns were fostered in the three prairie provinces by the land department of the Canadian Pacific Railway Company. The most profitable venture of the company in townsite promotion was, however, in Vancouver. By 1889 proceeds of town lot sales in that community exceeded those of all other company towns combined during that year.[16] A railway company report during this period mentions that "the townsites along the line, which have as far as possible been secured for the benefit of the company, are contributing handsomely to its revenue . . . total sales to December 31, [1887] have been

$1,399,327. Only a small portion of the company's interests in townsites have been disposed of, and its receipts from this source will rapidly increase as the country increases in population. . . ."[17]

It was only provident for the Canadian Pacific Railway Company to seek to derive the maximum financial benefit from its new townsites. If it had done otherwise it would have been quite unlike other land-grant railways who were not backward in securing for their treasuries any major profits arising out of the promotion of new towns. In the placing of towns in the western interior the Canadian Pacific Railway Company had complete cooperation from Ottawa. On March 11, 1882, the Department of the Interior withdrew from homestead entry "all even-numbered sections next to and along both sides of the Canadian Pacific Railway and its branches" thus creating a mile-wide belt reserve. Actually this was not done so much for the purpose of withholding lands from settlement until railway station sites could be located, as to forestall land speculation in the sections at the disposal of the government near the main line.

Not all townsites along the rail line were, in fact, monopolies of the company. At divisional points, for example, towns were laid out both on railway and on government land. Regina included two railway and two government sections. Moose Jaw comprised one railway and one government section. In most cases, however, main-line towns were originally provided for by the reservation of one section of railway land.

The belt of railway land grants in British Columbia presented surveyors and administrators with problems differing considerably from those encountered in railway belts in the western interior. In section 11 of the terms of union of British Columbia with Canada, and further formalized by 43 Vic. ch. 14 of 1880 and the Settlement Act of December 19, 1883 (47 Vic. ch. 14), a strip of land 40 miles wide, extending 20 miles back on each side of the Canadian Pacific Railway Company's projected main line, was transferred by the province to the Dominion. This grant applied to somewhat more than 500 miles of the rail line built from the summit of the Rocky Mountains to tidewater—actually from the present boundary with Alberta to a line drawn mainly north and south through New Westminster. In all, this strip, or British Columbia Railway Belt as it came to be known, contained 17,150 square miles or 10,976,000 acres. Terms of the settlement included provision for an annual payment by the Dominion to the province of $100,000.

Although the original intention was that this land should be given to the railway company in the form of a subsidy to aid construction, it was actually retained by the Department of the Interior until the return of the natural resources to the four western provinces in 1930. The areas of federal and provincial jurisdiction in the Belt were not, by any means, clear-cut. Both in the political and administrative spheres the Railway Belt of British Columbia continued to be a bone of contention for almost half a century. The wording of terms in the statutes of transfer were sufficiently vague to give rise to varying constructions of what was in the mind of the negotiators and legislators. The legal history of the Belt is an underbrush of statutes, orders in council, negotiations oral and written, and references to the courts, topped by an investigation of a Royal Commission in the late 1920s. It became impossible to ascertain precisely what lands in the Belt belonged to the Dominion and what lands to the province. In some instances where the lands clearly belonged to the Dominion, these had to be surveyed and dealt with by the provincial authorities.

One early result of this confusion over jurisdiction was that surveying operations in the Belt came to a standstill. When a surveyor arrived at a place where lands had been laid out or occupied under provincial authority he had to abstain from making any surveys in that vicinity. If he decided to proceed anyway his surveys could not be confirmed because such were not made as directed by regulations governing him. About 1897, after new negotiations, the representatives of the two governments worked out a compromise that ended the deadlock and allowed surveys to continue.[18]

It must remain a matter for conjecture whether the Canadian Pacific Railway Company was ever prepared to accept any land, to be administered by it, along the main line in British Columbia as part of a land grant in aid of construction. In any event, lands in the Belt conveyed to the Dominion were never turned over to the Canadian Pacific Railway Company except for its right-of-way, station grounds and ancillary purposes. At one stage the Dominion government reported that it had made very large expenditures for surveys and railway construction, totalling about $63,000,000.[19]

Jurisdictional controversies in regard to lands situated within the Belt as well as governmental disputes over the outer boundaries of the grant raged over this strip of territory for many years. A discussion about the precise extent of the Belt took place in Victoria in 1886 between the Surveyor General of Canada, E. Deville, and the Chief Commissioner of Lands and Works for the province, Hon. W. Smith. It was pointed out by the latter that a boundary 20 miles on each side of the main line of railway, from and following its sinuosities, constituted a most inconvenient arrangement. Following further deliberations and much correspondence, an agreement was reached to the effect that a boundary line following township boundaries should be adopted in order to achieve a definition of Belt limits clearer and more satisfactory than that contained in the Settlement Act.*

Later on the province objected that the Surveyor General of Canada, in drawing the new limits of the Belt, had measured the 20 miles from the extreme outward angle of the rail line, thus embracing a belt in many places very much in excess of 40 miles in total width. This method of measurement, it was claimed, gave about one million acres more in the grant than would an area contained in a ribbon of land 40 miles wide "having for its centre the average course of the line of railway." It was not until 1895,** after a series of proposals and counter-proposals that the two governments formally agreed upon a compromise solution.[20]

As early as 1880 there were overtures from the government at Ottawa to the British Columbia authorities, urging that land suitable for settlement in that province outside the Belt be granted to the Dominion in lieu of acreages already alienated by the province within the Belt. But the province, at the outset, took the view that it was under no obligation to do so.† A proposal from Ottawa by telegram in 1883 to its agent in British Columbia in these early negotiations, J. W. Trutch, that lands in the Peace River district of the province be so conveyed, marked another stage in these inter-governmental discussions. Later that year the province agreed to comply with the federal request and formally conveyed to Canada 3,500,000 acres in one rectangular block in that fertile area, lying between the 20th and 23rd base lines.[21] The final selection by the Dominion of this acreage was ratified in 1907.†† About the same time the terms of the Dominion Lands Act were made applicable to the Peace River Block. In 1930 the Crown in the right of Canada returned this block of land, along with the British Columbia Railway Belt, to the Crown in the right of the province.‡ At the time of this restoration considerably less than one million acres had been homesteaded in the Belt and only about 250,000 acres in the Block, where nearly 800,000 acres remained unsurveyed.

For purposes of surveys and general administration the British Columbia Railway Belt

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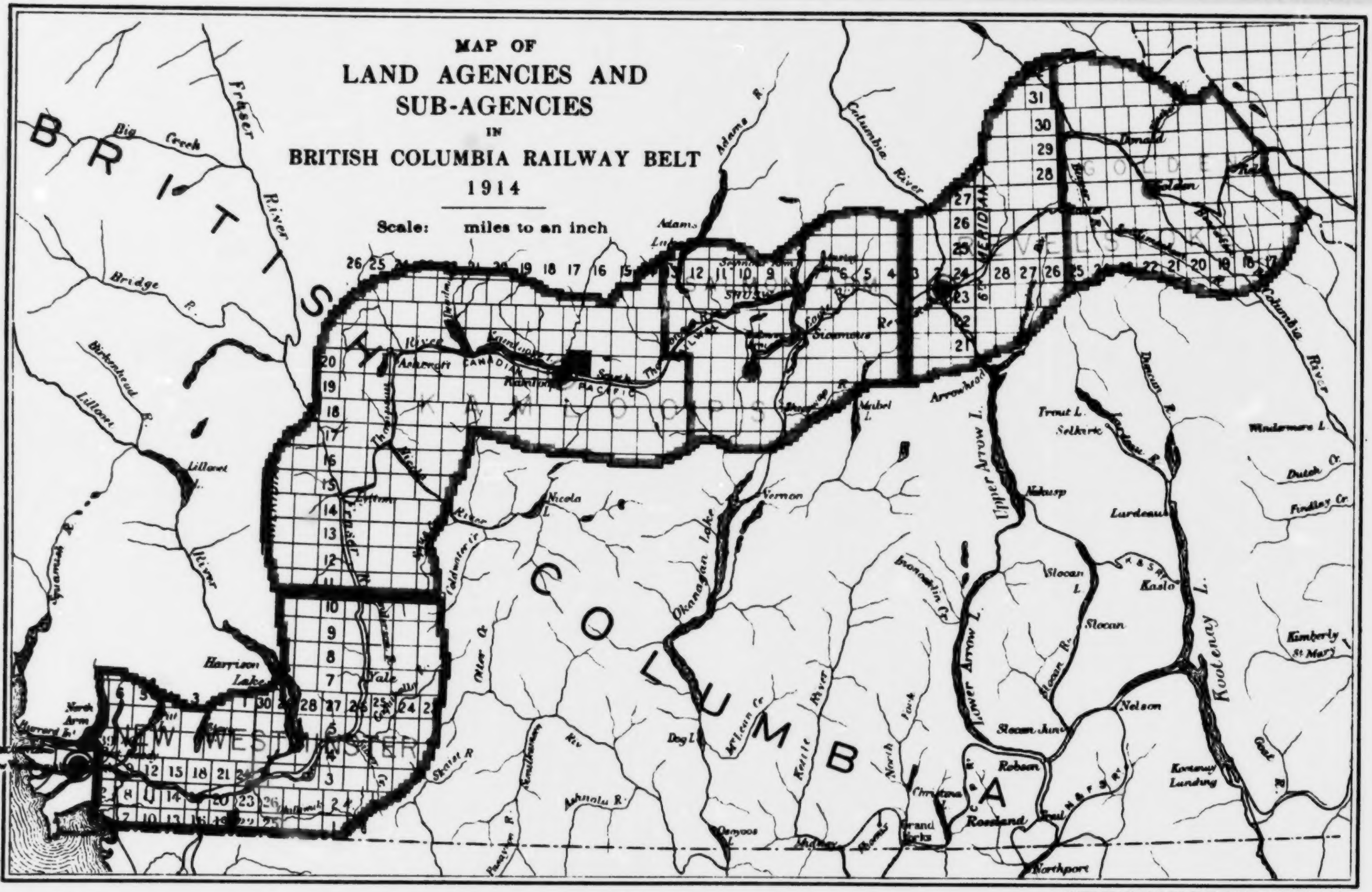
*Order in Council (Can.) May 27, 1887.

**58-59 Vic. ch. 4, July 22, 1895.

†Order in Council (B.C.) May 4, 1880.

††Order in Council (B.C.) May 15, 1907.

‡20-21 Geo. V. ch. 26, sec. 3.


MAP OF
LAND AGENCIES AND
SUB-AGENCIES
IN
BRITISH COLUMBIA RAILWAY BELT
1914
Scale: miles to an inch
BRITISH COLUMBIA
KAMLOOPS
NEW WESTMINSTER
REVELSTOKE
GOLDEN
6th MERIDIAN
CANADIAN PACIFIC
Fraser River
Big Creek
Bridge R.
Birkenhead R.
Lillooet
Lillooet L.
Squamish R.
Harrison Lake
North Arm
Burrard In.
Kamloops
Ashcroft
Thompson
Nicola
Lytton
Yale
Nicola L.
Coldwater Cr.
Otter Cr.
Similkameen
Skagit R.
Ashnola R.
Okanagan Lake
Vernon
Dog L.
Osoyoos L.
Kettle River
North Fork
Grand Forks
Christina
Rossland
Trail
Northport
Robson
Sicamous
Shuswap
Adams L.
Adams R.
Columbia River
Mabel L.
Arrowhead
Upper Arrow L.
Lower Arrow L.
Nakusp
Slocan L.
Slocan
Slocan R.
Slocan Junc.
Trout L.
Selkirk
Lardeau
Lardeau R.
Duncan R.
Kaslo
K & S Ry.
Kootenay L.
Nelson
Kootenay Landing
Goat R.
Kimberly
St Mary
Windermere L.
Dutch Cr.
Findlay Cr.
Donald
Golden
Beaver R.
Columbia River

MAP 5. Map of the British Columbia Railway Belt, 1914.

LITHOGRAPHED AT THE SURVEYOR GENERAL'S OFFICE OTTAWA CANADA

had been divided into five principal districts, namely, Upper Columbia Valley, Lower Columbia Valley, Shuswap Lake, Kamloops and the Coast District. Conditions varied greatly between most of these areas. In the Kamloops region, for instance, annual rainfall was light whereas in the Coast District it was heavy. Purposes of the survey in the Belt were to extend land measurements in the area and to classify lands considered suitable for settlement. For many years these surveys were performed by Dominion land surveyors commencing with preliminary work by William Ogilvie and Thomas Fawcett in 1885 as well as by O. J. Klotz in 1886 and W. S. Drewry, commencing in 1889. From 1906 to 1909 P. A. Carson carried out triangulation surveys of eastern areas within the Belt, covering a total of some 3,000 square miles. Morrison Parsons Bridgland (1878-1948) performed triangulation over some 2,000 miles in western parts of the Belt from 1910 to 1912. In the 1914 season Bridgland was instructed to retrace Drewry's work and to mark permanently all survey stations not previously marked. Bridgland has recorded that in order to establish accurate known points throughout the Railway Belt from which new surveys could be commenced and corrections of former surveys checked, a triangulation survey was essential.[22] In this work a direction theodolite made by T. Cooke and Sons of York, England, was used by him. One serious difficulty faced by these pioneer surveyors in mountainous regions of the West was the lack of sufficient time to reach survey positions on mountain tops. In the mornings these climbs often required 4 to 6 hours to complete and descents usually consumed several hours in the early evenings. Under the most favorable circumstances three hours were required to set up instruments and read a set of angles. Any delay due to clouding, smoke haze from forest fires or in the interpretation of indistinct signals added to time pressures on the surveyor. To help offset this his camp was nearly always taken to the timber line below the peak being scaled.

The survey of lands in the Belt was conducted under the Fourth System which comprises a slight modification of the Third System of the Dominion Lands Survey System. The departure consisted in adding to each quarter-section of 160 acres, an allowance of three acres for roads rather than locating roads along section lines as on the prairies. Among those federal and provincial surveyors who accomplished important work in the Railway Belt of British Columbia from 1906 to 1912 were J. A. Fletcher, A. O. Wheeler, E. W. Robinson, R. D. McCaw, J. E. Ross, J. A. Kirk, N. C. Stewart, T. H. Plunkett, W. J. Deans, A. J. Campbell, A. V. Chase and D. Alpine Smith.

The nature and extent of the special problems faced in surveys in the Belt is revealed in an 1887 report to Surveyor General Deville by Chief Inspector of Surveys W. F. King.[23] King pointed out that although much of the Belt consisted of mountain ranges, it included many fertile valleys as well. But in some instances areas of good farming lands were rather widely separated. Two survey methods were applicable to this type of terrain, namely, either to lay out isolated townships regardless of any regular system or to follow the prairie system of rectangular, adjoining townships. The advantages of the latter method, with its easily decipherable designation of land parcels, as well as in extending or re-establishing original surveys, resulted in its adoption. As it was clearly impossible to follow customary procedure in projecting base lines and township outlines in such rugged country, resort was had to the survey of the Canadian Pacific Railway Company's main line. Its right-of-way afforded a relatively easy survey route and formed a suitable base of operations for surveyors throughout the Belt. Instrumental stations were usually established on the railway roadbed and were not permanently marked on the ground, though many of them have been perpetuated by witness or reference posts. From these posts it was possible for surveyors to locate the nearest section corner with as much accuracy as if the base and other lines had been projected all the way from the Principal Meridian in Manitoba.

Field work was performed by William Ogilvie in 1885 from Port Moody to Revelstoke and in the same year in the Kamloops District by Thomas Fawcett, D.T.S. Astronomic survey work from the summit of the Rocky Mountains to Revelstoke was accomplished in the following year by O. J. Klotz, D.T.S., assisted by Thomas Drummond. In his diary on April 21, 1885, Klotz makes this entry:

"This evening I received the most agreeable news that I was appointed by the Dominion Government as Chief of the Astronomical Observations to be conducted in British Columbia and the North West. This is the highest honor I have received yet and I hope I will prove worthy thereof". By the time Riel was being captured at Batoche, Klotz was on his way across the continent to begin work on the west coast.

The Seattle Chronicle of June 8, 1885, records the presence of the eminent Canadian surveyor in that city,

"Otto J. Klotz of Ottawa, Canada, astronomer for the Canadian government, has been in the city since last Sunday and has established an observatory . . . Mr. Klotz has one assistant,* who is now at Victoria. As soon as the nights are favorable he will ascertain the longitude of that place . . . .

"The determination of the longitude of a place is made from a base station. From this point, as well as from that whose longitude is wanted, observations of the transits of certain stars are taken, and the times of the transits carefully noted by a chronometer. The astronomers then go to the telegraph offices at their respective stations and compare the times of the transits by means of telegraph. The difference in time between the base station and that whose longitude is desired is ascertained and verified by frequent repetitions and comparisons. Having once ascertained accurately the difference in time, the determination of the longitude becomes a mathematical matter of easy accomplishment.

"Mr. Klotz will ascertain, after having found the longitude of Victoria, that of Kamloops, which he will make the base station for determining the longitude of points in British Columbia. The purpose of this work is to obtain the accurate location of points to which to refer land surveys hereafter to be made by the Canadian government".

Klotz was keenly sensitive to the grandeur and majestic beauty of British Columbia scenery but occasionally indulged himself in over-pessimistic entries about the coast climate in his diary. On September 17, 1885, for example, one reads:

"Seven weeks and not one single continuous clear night or 4 hours [consecutive]. Port Moody [at the head of Burrard Inlet] may become a vast city, she may have churches, mansions, colleges, universities but never, never a field observatory".[24]

In contrast there were light-hearted moments in the field: "[Sept. 24] I observed the partial [4/5] eclipse of the moon this night. I set up tripod and zenith telescope and at night observe for time and set in azimuth. Drummond brings a guitar and we spend some time pleasantly together in my tent therewith, alternately playing and singing . . . ."

On November 4, 1885, Klotz commented, "Today is memorable in marking the completion of the lesser metallic girdle, the telegraph [line] that now encircles fair "Canada" to be followed in a few days by the greater one, the Canadian Pacific Railway". (Author's note: The final spike was driven by Donald Smith in the ceremony at Craigellachie in Eagle Pass on November 7 at 9.22 a.m.) "I was the first aboard the directors' train, saw Mr. Van Horne, the C.P. vice-president, also H. J. Cambie, C.E., and Major A. B. Rogers, the discoverer of the Pass through the Selkirk range". "[Nov. 17] Ogilvie's traverse has not reached Farwell [Revelstoke] yet either".

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*Thomas Drummond, D.T.S.

In Ottawa, early in the following year, Klotz was introduced to a very human but rather dismaying aspect of bureaucracy in the capital city:

"In forenoon [Feb. 17] called on W. Pearce, also [Deputy Minister of the Interior] A. M. Burgess, also [Surveyor General] E. Deville and Chief Inspector of Surveys W. F. King. In afternoon called on Amos Bowman, Dr. Bell, Prof. Macoun, all of the Geological Department. What has struck me this time . . . is the extreme jealousy that exists between officers of the same department . . . Prof. Macoun told me that the geologists' [topographical] surveys are unnecessary, that we [land surveyors] should do all that . . . ."

On the evening of July 31, 1886, William Ogilvie reached the site of Klotz's camp from Kamloops and the two surveyors went to work at once on the contents of the former's field books, checking the azimuths. Later in the summer Klotz consulted his conscience in the matter of naming a summit in the Rockies after himself: "In the afternoon [August 12] I triangulated three mountains, the largest, Mount Begbie. I named the other two, Mount Klotz and Mount McArthur. It is probably a delicate matter to name a mountain or lake after oneself but when I ask myself candidly who has the first right, the appropriate one to claim the name, it certainly is the explorer, the man who measures them, locates them, climbs them. My eyes are not the first to gaze upon these mountains but they have been nameless, and I am the first to give them their geographical and topographical position".

FIGURE 39
Dr. O. J. Klotz.

As matters turned out Klotz was unnecessarily anxious over the long-term consequences of his action. His superiors in Ottawa must have discarded the name "Mount Klotz" at that time. It was not until December, 1957, that a peak in the southern mountains of British Columbia was named for him with official approval. In the meantime, in August, 1945, a mountain in the Yukon was given his name. James Joseph McArthur (1856-1925), the fellow surveyor in whose honor Klotz named a Kootenay peak, shares the distinction with Klotz in having both a British Columbia and a Yukon summit named after him. Born in Aylmer, Quebec, McArthur was commissioned a Dominion land surveyor in April, 1879. He then engaged in meridian, base-line and subdivision surveys until 1886 when he began work in the southern Rockies. All these activities constituted an impressive prelude to a distinguished later career in international boundary surveys and related affairs.

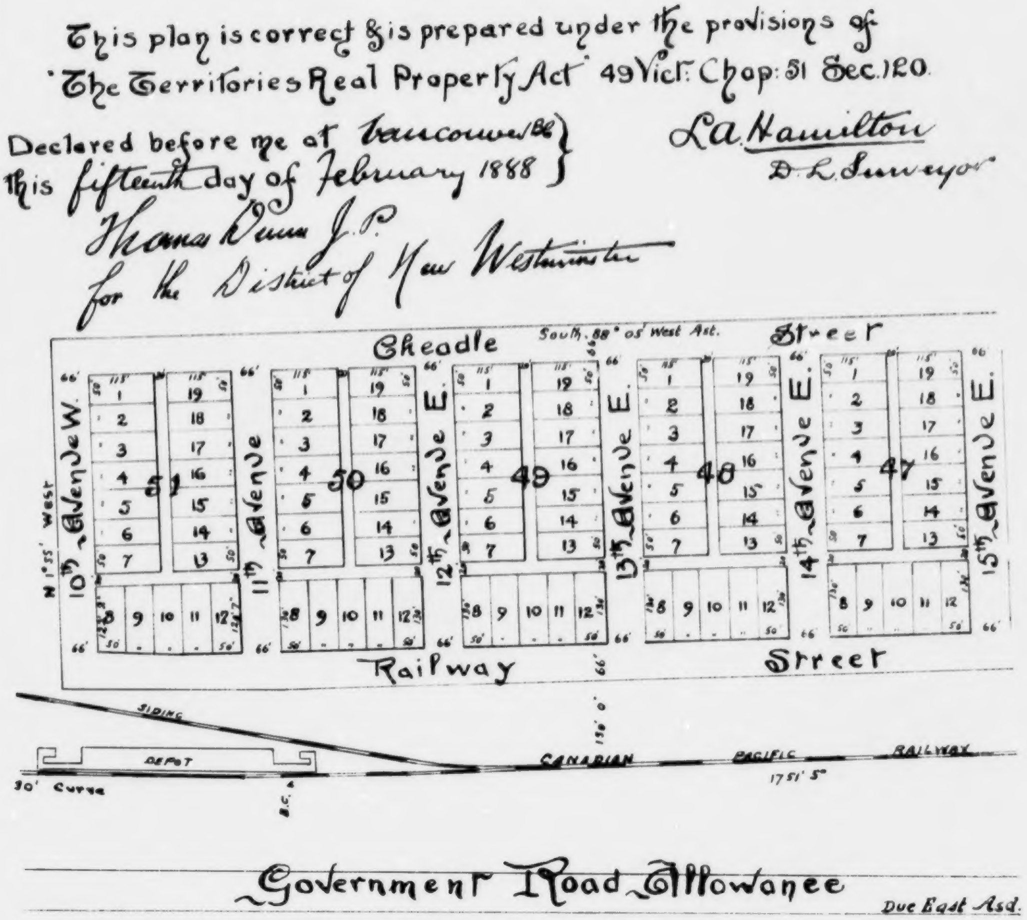
Surveying in the Rockies involved the running of risks of a kind not encountered in other parts of Canada. Klotz, in a diary entry dated May 19, 1886, describes in graphic language a major occupational hazard in mountain regions: "Continue the traverse. This forenoon was almost one continual thundering of snow slides—these are always accompanied by rocks which have been loosened by frost. While we were at dinner a slide occurred from the mountain [Mount Stephen] adjoining us. The snow flowed like water and the huge rocks poured down like an immense hail storm. What a noise—what a sight as it leaped from ledge to ledge and over precipices until it reached the base in front of us, the thunder reverberating amongst the adjoining mountains. Some of the slides came to and over the track and I was glad when I got away from there with my instruments".

There were other dangers to one's health and general welfare. But in regard to one of these menaces Klotz disclaimed any ill effects. He had no difficulty in breathing in the rarified atmosphere of the high Rockies but confessed to near-exhaustion on reaching camp in the evenings. He acknowledged that he was so physically tired at the end of a day's work that he had little or no appetite for food.[25]

Some of the most notable land surveyors in Canada's history developed their talents and reputations through their connection with the early railway surveys in the western interior. Lauchlan Alexander Hamilton (1852-1941), who became a qualified surveyor in Manitoba and British Columbia, was commissioned as a Dominion land surveyor in April, 1879. The following year he joined the Department of the Interior, empowered to organize its timber, mineral and grazing lands branch. Late in 1880 Hamilton was summoned to the office of his deputy minister and introduced to a group of men, including George Stephen and R. B. Angus of Montreal. It was explained to him that the matter under consideration was strictly confidential because the group he had met was about to enter into a vitally important contract with the Dominion government. As only one draft of the contract was available in the office Hamilton was asked to read it so that he would be cognizant of the background of future discussions involving him. After reading the draft Hamilton withdrew from the meeting. This brief encounter with leaders of the Canadian Pacific enterprise led in time to the offer to this Penetanguishene-born surveyor by the Canadian Pacific Railway Company of the post of assistant land commissioner to that company. In accepting this appointment Hamilton began a connection with the railway that lasted for 20 years. By 1888 he had been elevated to the land commissionership. During the period of that office he administered one of the largest estates of land holdings in North America. He was the executive officer responsible for the selection of lands out of government land subsidies to the Canadian Pacific and its subsidiary lines.

Hamilton's initial work with the railway company was the selection, in advance of actual construction, of locations for stations and townsites on the main line west of Winnipeg. In this connection he became the godfather, if not the father, of Regina, Moose Jaw, Swift Current, Medicine Hat and Vancouver. The first subdivision in Calgary is known as "Plan A, Calgary" and is signed by A. W. McVittie, Dominion land surveyor, on January 1, 1884. In 1884 Hamilton went to the Pacific seaboard to help create the new settlement of Vancouver at a time when cedar forest largely covered the site near Coal Harbour, a community then bearing the name of Granville. Clearing the site in preparation for the extension of the railway around the south shore of Burrard Inlet from Port Moody was an undertaking of considerable magnitude. J. W. Stewart, who as General Stewart was in charge of Canadian railway construction in France in the First World War, was an assistant to Hamilton in those formative times on the West Coast.

Today, on a bank building at the corner of Hamilton Street and Hastings Street West (Victory Square) is a bronze plaque bearing the inscription: "Here stood Hamilton, first land commissioner, Canadian Pacific Railway, 1885. In the silent solitude of the primeval



This plan is correct & is prepared under the provisions of
"The Territories Real Property Act" 49 Vict. Chap: 51 Sec. 120.

Declared before me at Vancouver BC
this fifteenth day of February 1888

L.A. Hamilton
D.L. Surveyor

Thomas Dunn J.P.
for the District of New Westminster

Cheadle Street
South 88° 05' West Ast.
10th Avenue W.
11th Avenue
12th Avenue E.
13th Avenue E.
14th Avenue E.
15th Avenue E.
51
50
49
48
47
N 1° 25' West
Railway Street
Siding
Depot
Canadian Pacific Railway
1751' 5"
30' Curve
B.C.
136' 0"
Government Road Allowance
Due East Ast.

FIGURE 40. Plan of Swift Current, Saskatchewan.

forest he drove a wooden stake in the earth and commenced to measure any empty land into the streets of Vancouver".

In order to bring about the transfer of the Canadian Pacific Railway Company's terminal from Port Moody to Vancouver the British Columbia government agreed to grant to the railway 6,000 acres for what became known locally as the "C.P.R. Townsite." Out of this area the railway company selected sites for the railway station, hotel, yards and water-frontage property on which to build docks. All these developments were on land first surveyed, to some extent, by the Royal Engineers under Col. R. C. Moody. But it was on the spot now marked at Victory Square that Hamilton stood 22 years later, as surveyor in charge of a party consisting of transitman, leveller, rodman, chainmen, picketman and axemen. They commenced the survey of an area 5 miles long and 2 miles wide, now constituting the central core of a metropolis extending for many miles on both sides of Burrard Inlet.

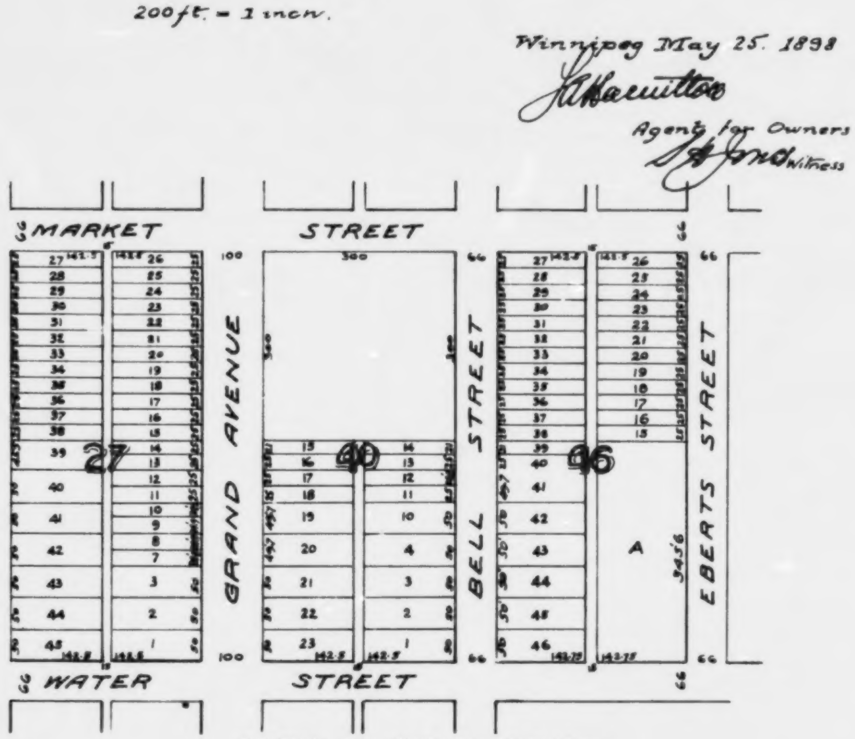


FIGURE 41. Plan of Indian Head, Saskatchewan.

In 1886 what is now known as The Great Fire swept the tiny community and struck savagely at the ambitious survey project. Preliminary plans for laying out streets and blocks in Vancouver were destroyed. Heat from the holocaust was so intense when Hamilton managed to escape from the doomed Ferguson Block that a number of valuable documents were burned under his arm and the lens cracked in a survey instrument he was carrying.

In April, 1938, on his golden wedding day, Hamilton was made the First Freeman of the City of Vancouver. In part, an illustrated address presented to him on that occasion stated: "You saw this great metropolis and world port as a silent wilderness of forest . . . and with your hands marked its place, planned its streets and named them, served without reward as our senior alderman on our first Council, strove to acquire for us our magnificent Stanley Park, preserved our Cambie Street Grounds and succored the distressed in the Great Fire. All Vancouver acknowledges your worthy services in laying the foundations of this beautiful home for a happy people".

On May 24, 1887, amid banners with slogans such as "From Ocean to Ocean" and "Confederation Accomplished" and to the cheers of enthusiastic crowds the first train reached Vancouver sharp on scheduled time. As Van Horne had declared to the land commissioner-surveyor three years previously, "Hamilton! Hamilton! This is destined to be a great city, perhaps the greatest in Canada, and we must see to it that it has a name commensurate with its dignity and importance, and Vancouver it shall be if I have the ultimate decision". At the time Hamilton died in 1941 he was the last surviving member of the first Vancouver City Council. Mrs. Hamilton was the first woman member of the Toronto City Council.

Another notable figure in the early western railway surveys was Major Richard Carney Laurie (1858-1938) a graduate (gold medallist) from Royal Military College, Kingston, and commissioned a Dominion land surveyor in April, 1883. But in 1881 Laurie was engaged as topographer to a survey party headed by W. E. Secretan, C.E., working on locating the main line of the Canadian Pacific Railway from Brandon to near Broadview. Today a small community, upwards of 90 miles west of Regina, commemorates the name of the chief of that particular railway survey party.

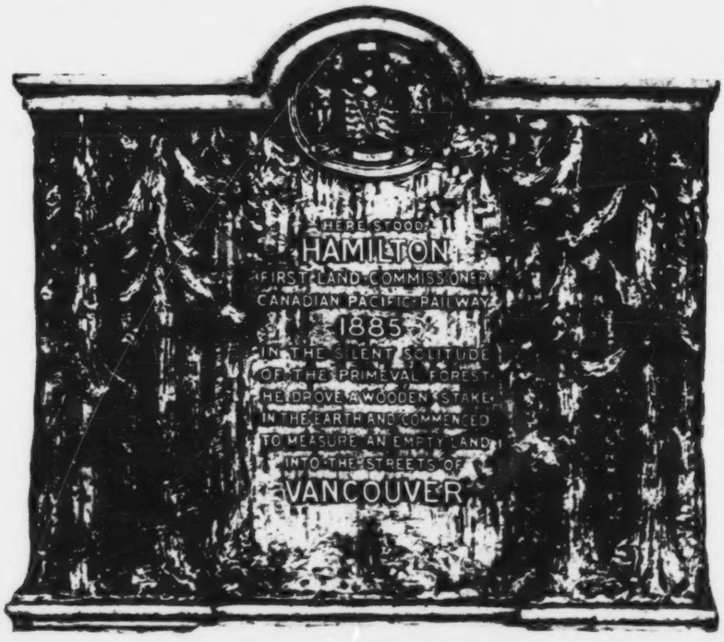

HERE STOOD
HAMILTON
FIRST LAND COMMISSIONER
CANADIAN PACIFIC RAILWAY
1885
IN THE SILENT SOLITUDE
OF THE PRIMEVAL FOREST
HE DROVE A WOODEN STAKE
IN THE EARTH AND COMMENCED
TO MEASURE AN EMPTY LAND
INTO THE STREETS OF
VANCOUVER

FIGURE 42. Inscription on bronze panel, Victory Square, Vancouver, southwest corner of Hamilton and Hastings streets, marking the place where the initial survey stake was driven during the winter of 1885-86.

Also a graduate of Royal Military College, Walter Beatty Young (1880-1965), surveyed for the Canadian Pacific Railway in the first years of the twentieth century in the establishment of new townsites on branch lines then being opened up in what is now the province of Saskatchewan. Young was named after Walter Beatty (1836-1912), a well-known Dominion and Ontario land surveyor. In time Young became Examiner of Land Titles for Manitoba, retiring from that post in 1950, after 40 years service in that capacity. Young also served under P. A. Wilkin on railway right-of-way surveys.

Another Winnipegger, Wilfred Humphreys (1891-), became Chief Surveyor of the Canadian Pacific Railway Company in 1932. He began his surveying career in 1912 with

Wilkin on right-of-way surveys in Manitoba and with W. J. Deans in Manitoba and Saskatchewan the following year. He performed similar work in British Columbia under two surveyors, J. Lonsdale Doupe and N. C. Stewart. One task allotted to him was the determination of the number of D.L.S. monuments lost under the destructive Frank Slide of 1903. Humphreys, in addition to being a Dominion land surveyor, became a Provincial land surveyor in Manitoba, Saskatchewan, Alberta and British Columbia.

The man mainly responsible for the selection of the site of the City of Regina was Hon. Edgar Dewdney (1835-1916), the surveyor who arrived in British Columbia in 1859 and made a splendid reputation for himself. Highly successful as a Conservative candidate he served, in between two terms in the House of Commons at Ottawa, as Lieut.-Governor and Indian Commissioner of the North West Territories from 1881 to 1888. After a three-year term as Minister of the Interior, Hon. Mr. Dewdney became Lieut.-Governor of British Columbia, occupying that high post from 1892 to 1897.[26]

As early as May, 1888, Dewdney was on record as favoring the crossing of Pile of Bones Creek for the site of a capital of the North West Territories. The vicinity of this place possessed few natural features to commend it as a future urban settlement. Water sources, hills and trees were practically nonexistent but in all directions stretched some of the best wheat-growing lands on the North American continent. For administrative purposes it was a central location and, as another advantage, there were few speculator-squatters in the area.

The opportunity to reap substantial profits from real estate transactions arising out of the development of the new townsite was highly tempting. Dewdney and his business associates formed several land syndicates in 1882, purchasing upwards of 30 sections of Hudson's Bay Company lands adjacent to the future route of the Canadian Pacific Railway in what is now southern Saskatchewan. One parcel of land a Dewdney group owned was the south half and northwest quarter of Section 26, Township 17, Range 20, west of the Second Meridian. This property later became part of central Regina. However, the Canadian Pacific Railway Company to some extent thwarted the syndicate's hopes for dividends on its investment by building their railway station two miles east of Section 26. Newly-arrived immigrants tended to settle near the station rather than travel eastwards to the intersection of the main line with Wascana Creek. Thus, for a time, there were two settlement sites in Regina.

Arrangements were made in 1882 for a survey of the town and to have the lots put up for public sale. The survey included the station area and a strip adjoining but not including that part of Section 26 from Prince Albert to Pasqua streets. This was a Canadian Pacific Railway Company's victory over its rivals in the race for townsite development. By 1883 only a negligible number of lots in Section 26 had been sold, but at least $500,000 worth of land had been sold from the officially surveyed site.

A group of townsite trustees authorized the subdivision of the new townsite into lots. Today the names of those trustees, E. B. Osler, W. B. Scarth, Donald Smith and R. B. Angus, are commemorated in the names of well-known city streets. So also is the name of the surveyor who acted in 1882 on their instructions, L. A. Hamilton. J. H. McTavish, then Canadian Pacific Railway Land Commissioner, and Hamilton as assistant, signed the plan, known as "Old 33" and drawn to a scale of 200 feet to the inch.[27]

The plan of Regina was quite orthodox in concept, being a rectangular grid with few crescents, circles or large irregular lots. Residential lots generally were 50 feet by 125 feet. Lots in the business section were 25 feet by 125 feet. Main streets were made 100 feet wide, others 66 feet wide. In six weeks what had been but a few frame homes and a scattering of tents became a thriving community graced by 8 hotels, 18 stores, 2 livery stables, 2 laundries, 4 lumber yards and 3 billiard halls supported by a population approaching 9,000.

In 1882 Hamilton also surveyed the townsite of Moose Jaw and drew up the first plan of subdivision for that community.[28] Swift Current, Grenfell and Medicine Hat owe their original subdivision plans to the same man, the first plan of the latter settlement being signed by Hamilton in January, 1888.[29] Plan A of Calgary was signed by A. W. McVittie on January 1, 1884.[30] Indian Head was first laid out by G. A. Stewart in 1884. It was resurveyed 14 years later by J. Lonsdale Doupe. All three men were qualified Dominion land surveyors but Hamilton was surveying for the Canadian Pacific Railway Company at the time. The railway company had done well in its efforts to produce the greatest possible profits from its townsite projects. But the day of railway land grants was slowly coming to an end. In 1894 Parliament voted the last of these subsidies when the Minister of the Interior, Hon. T. M. Daly, asked for approval of a grant of 6,400 acres per mile in favor of the Rocky Mountain Railway and Coal Company in west-central Alberta and the same amount of acreage for a Canadian Pacific line from near Souris to Pipestone Valley. These were free grants to the companies, subject only to the payment by the grantees of the cost of surveying the land plus incidental expenses. Sir Clifford Sifton once remarked that the railway land-grant system came to an end in Canada for the reason that the federal government had come to the end of eligible land reserves that were acceptable to the railway.[31]

It is interesting to note that during the same session of Parliament Daly introduced a measure of three short clauses providing that where a person could prove that he squatted on what turned out to be school lands in a township, prior to surveys, such person would be offered a quarter-section elsewhere in substitution for the land he surrendered. This arrangement only applied to school lands.[32]

Partly because of their dramatic feuding with the elements and other challenging aspects of nature, surveyors in the field in Canada have generally won more widespread recognition of their accomplishments than have their fellow professionals engaged in the less glamorous but nonetheless essential duties of departmental administration. This imbalance of credit is also found in the realm of railway surveys. Men like Robert Evans Young (1861-1911) laboring at office desks in Ottawa or elsewhere, contributed in an important way to the advancement of Canada during the era of transcontinental railway construction. Born in Georgetown, Ontario, Young arrived in Winnipeg in the early 1880s. In 1882 he became a Manitoba land surveyor and a Dominion land surveyor. Better known, perhaps, for his special survey of the city of Winnipeg, nevertheless the years he spent in Ottawa were of solid value to the nation. Early in 1901 he was appointed Superintendent of Railway and Swamp Lands, Department of the Interior. His function was to examine titles to lands held by railway companies in receipt of land subsidies from the government. Young devised a system of making prompt transfers of titles and lands to the companies entitled to these patents. He was highly praised by the Deputy Minister of the Interior for his methodical and efficient administration of this special project as well as in the supervision of transfers of swamp lands to Manitoba.

The vision of government leaders, the courage of explorers, the enterprise of financiers, engineers and builders, the labor of nameless workmen, the exertions of pioneers in surveying as well as in land policy concepts and administration, had combined to make physically and financially possible this initial rail connection between Central Canada and British Columbia. This triumph over almost endless adversities and obstacles meant also that Canada was at last linked by ribbons of steel from ocean to ocean. Confederation, long a vision of statesmen, had become a living dynamic, unifying reality.

The directors' train, the first to travel over the new route officially, rolled westward on November 7, 1885 from Eagle Pass on the final 340-mile lap to the Pacific Coast. On the following day this history-making caravan had reached Pacific tidewater at Port Moody.

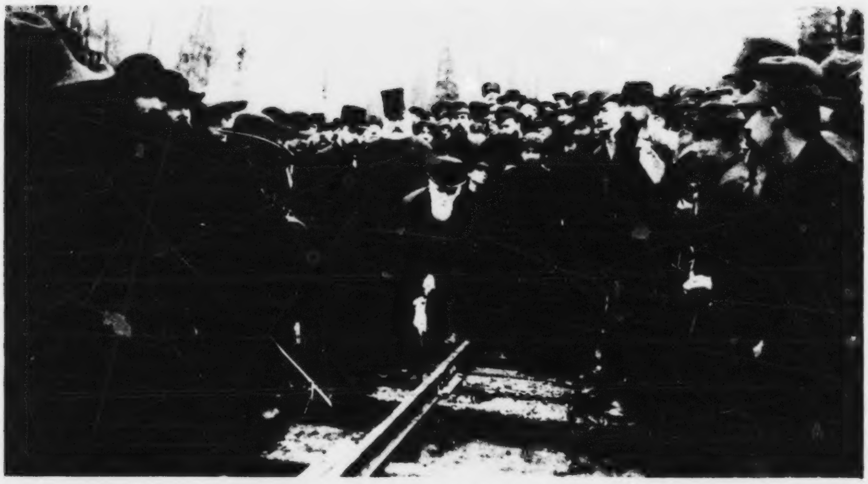


FIGURE 43. Driving of the last spike by Donald A. Smith (later Lord Strathcona) during the completion ceremony on the C.P.R., Nov. 7, 1885.

Its running time from Montreal, exclusive of stops, was a creditable 5 days at an average speed of 24 miles per hour. When Donald Smith had driven home the last spike in the main line of what was to be the first transcontinental railway system in Canada, someone called upon the general manager of the Canadian Pacific for a speech. Van Horne was content to reply, happily and concisely, "All I can say is that the work has been well done in every way." Those simple, telling words of deeply-felt appreciation, voiced on behalf of all Canadians, could well resound indefinitely among the British Columbia mountains whose names commemorate the services to Canada performed by men who helped unlock many of the secrets of the high ranges, surveyors such as Bridgland, Campbell, Dennis, Deville, Fleming, Jarvis, King, Klotz, McArthur, Ogilvie, St. Cyr, Wheeler and White. Among these names of eminent surveyors of the early West none shines more brightly than that of Arthur St. Cyr (1860-1923), born at Ste-Anne de la Pérade, Quebec, and who served as articled student with Henry O'Sullivan of Ancienne-Lorette before embarking upon his long, active and distinguished professional career as a Dominion land surveyor.

6

CANADIAN IRRIGATION SURVEYS 1885-1900

The introduction in the mid-1890s of large-scale irrigation in Canada's West came a number of years after the practice had become well-established in several western states of the American Union. To some extent Canadians were able to benefit from hard lessons below the border in this special branch of agriculture.

The so-called "arid region", or area of light rainfall, in the North West Territories was defined in 1895 as an area bounded on the south by the international border, on the east by the 2nd Initial Meridian, on the north by latitude 51°30′, and on the west by the summit of the Rockies. Generally the soil in this region was regarded as being exceptionally fertile. By far the most extensive developments in Canadian irrigation have taken place in the western part of this 50-million acre empire, extending from Medicine Hat to the foothills. The region is watered by nine principal streams, the Red Deer, Bow, Elbow, Highwood, Waterton, South Saskatchewan, Old Man, Belly and St. Mary's rivers and their tributaries.

The first important attempt at irrigation in this part of Canada was made in 1879 by John Glen, a squatter near Fish Creek, a few miles south of Calgary. Glen constructed a small ditch and diverted water from the creek to irrigate some 15 acres of crop.[1] In 1882 an irrigation ditch was completed near Lethbridge. In 1883 an experimental ditch was constructed at High River but results from this project were not satisfactory. Reports of Dominion land surveyors over a span of years frequently stressed the need for irrigation in this region. But it was mainly the persistent advocacy of surveyor William Pearce (1848-1930) that finally produced a public awareness of the problem and the opportunity. In 1891 an irrigation ditch, designed to water 160 acres, was constructed by John Quirk to take water from the North Fork of Sheep Creek to Township 20, Range 4, west of the 5th Meridian. So successful was this effort that Quirk's neighbors at once constructed similar ditches and by 1894 nine irrigation systems were being supported by that diversion.

In the 1885 annual report of the Department of the Interior, Burgess, as deputy minister, stated, "Mr. Pearce raises what is practically a new question when he discusses the irrigation

FIGURE 44
Col. J. S. Dennis.

of completely dry tracts in the grazing country . . . It will be a long time before the regular system of settlement which commenced at Red River in 1870 . . . will reach the class of country to which [his] suggestions relate . . . ". The period of time Burgess had in mind in this regard is conjectural but, in any event, within ten years of his prophecy extensive Dominion land surveys had been made in this area and some sizable irrigation works constructed on the framework of those surveys.[2]

In the late 1880s irrigation projects in the region were given strong impetus by the arrival in what is now the Cardston area of Alberta, of a group of Mormons from Utah. These immigrants were familiar with irrigation practices and possibilities. Within a few more years several Canadian companies came into existence whose objects, wholly or in part, were to promote and extend irrigation facilities in these southern areas of the high plains. Among these corporations were the Calgary Irrigation Company and the Alberta Railway and Irrigation Company.

The need for Canadian legislation that would place irrigation activities on a sound legal and statutory basis became more and more pressing. During the visit to Calgary of Hon. T. M. Daly, Minister of the Interior, in the early winter of 1892, the necessity of a complete topographic survey in preparation for large-scale irrigation in the region was brought to his attention. As a result departmental officials at Ottawa were asked to prepare a bill authorizing irrigation suitable to the conditions of the south country. During the 1893 session the bill was introduced in the Commons. Owing to the absence from Ottawa of the Prime Minister, who was in Paris attending meetings of the Bering Sea Commission, it was decided to advance the bill to second reading stage only. It was also thought advisable to postpone further parliamentary action until there was an opportunity for wide public discussion of the measure. The draft bill was circulated among interested parties and constructive criticism invited. During this interval J. S. Dennis, Jr. was sent on a tour of western United States in order to study and report to the government at Ottawa upon American irrigation laws and practices. On his return Dennis, in December, 1893, submitted a full report and in the light of his recommendations together with other suggested changes, the bill was re-drafted and introduced in the 1894 session. A delegation from Calgary, Lethbridge, Medicine Hat and Fort Macleod made the trip in May of that year to Ottawa to press for passage of the bill. The Canadian Pacific Railway materially aided the delegation by providing free transportation for the purpose.

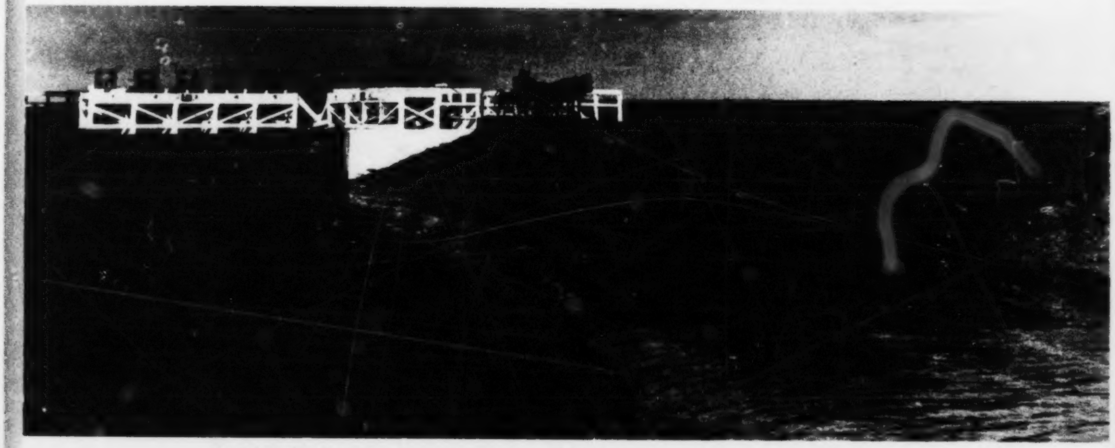


FIGURE 45. Head gates and reservoir on C.P.R. irrigation system in Southern Alberta.

Dennis, in his report, had recommended total supression of all riparian rights in irrigation water and urged that these rights be transferred to the Crown in the right of Canada, for the benefit of the greatest number of users. Secondly, he advocated measures of protection of individual consumers of irrigation water and, thirdly, the imposition of safeguards covering all types of water transactions within distribution systems. The vesting of control of irrigation water in one strong central authority was made a cardinal principle of the new bill.

A general topographic survey of the dry area of the Far West was considered essential. In outlining a suitable method of survey Dennis observed that "to determine limits of the drainage basins and prevent the diverting of water from the district to which it properly belongs and the attempt, so disastrous . . . in the United States of America, to bring more land under irrigation in a certain district than its water supply would warrant . . . the work to be undertaken by the Canadian irrigation survey covers widely different branches of both engineering and surveying. We have to deal with questions of geographical and topographical surveying, hydraulic engineering and the structural branches of civil engineering".

The North-West Irrigation Act (57-58 Vic. ch. 30), based on these fundamental principles, became law on July 23, 1894. By an order in council in the following October rather extensive additions were made to the regulations concerning the manner of surveying and preparing returns of surveys of the right-of-way for irrigation ditches and related works. Right-of-way surveys were classified as (1) preliminary and (2) final. Preliminary surveys were those made with proposed locations of main ditches and laterals staked out to enable applicants to file preliminary plans. Final plans were those drafted when ditch routes had been finally located and construction was under way, thus permitting plans to be filed and title to the rights-of-way formally conveyed.

In the summer of 1895 Parliament passed a supplementary measure (58-9 Vic. ch. 33) section 7 of which provided that all maps and plans in connection with irrigation works had to be signed and certified correct by a Dominion land surveyor. Three years after passage of the first federal law on irrigation the existing acts of parliament on the subject were amended and consolidated in one piece of legislation (61 Vic. ch. 35).

Four years previously William Pearce, in his report to the Department of the Interior, had observed in describing a visit to what is now southern Alberta, "When in the neighborhood of the Mormon settlement I took occasion to go over a stretch of country that I had not seen before, to the east of St. Mary's River, township one, to Lethbridge. I found an extensive tract of slightly undulating country with a strong clay soil. I think that St. Mary's River could be cheaply brought on to irrigate this tract and, if this were done, it would be second to none in Canada".

Just prior to the introduction in Parliament of the pioneer bill on irrigation in Canada, Pearce reported upon the western rainfall areas located along the main line of the Canadian Pacific Railway.[3] Pearce advised that "Examination . . . of the physical conformation of the country between Medicine Hat and the Fifth Principal Meridian [which passes through Calgary at 114° west longitude] leads . . . to the conclusion that there are large areas in that region which could be satisfactorily and profitably irrigated by waters of Bow River . . . about 3 million acres could thus be reclaimed from comparative aridity and rendered productive for all purposes of mixed farming . . . in order to induce a company organized . . . to undertake the work of irrigating all or any of these tracts, it will be necessary that the sectional system of survey should be abandoned, that the road allowances provided for in the Dominion Land Act should be closed up [and] that the area falling to the school endowment should be provided for in a single block. . . ".

In 1894 the Canadian Pacific Railway Company made some preliminary surveys to determine upon the feasibility of diverting water from Bow River near Calgary to serve lands adjacent to the Canadian Pacific main line east of that settlement. Apparently the result of this examination was favorable and the prospects of transforming these areas into acreages of benefit to the company and the nation at large seemed good.

Early that same year Burgess and Pearce joined in a submission to Interior Minister Daly concerning government policy in the western area of light rainfall. They urged extensive irrigation from Bow River, suggesting the reclamation, in this way, of upwards of three million acres.[4] When Van Horne was approached and concurred in another key recommendation in this report, namely, that large compact blocks of railway subsidy lands be substituted in the arid region for the regular provision of alternate sections only, the way was cleared for the passage through Parliament of the statutory approval necessary to the advancement of this immense irrigation project.[5]

Daly spoke briefly on this bill in the Commons in July of 1894, indicating that the measure was being introduced to enable the government to convey to the Canadian Pacific Railway Company, as part of the original main line grant, tracts of land composed of whole townships, i.e. both odd- and even-numbered sections. The minister explained that this bill concerned land requiring irrigation and that the millions of acres involved would be "fairly fit for settlement" in the view of the company, only if it was artificially watered. Roughly the land under discussion covered an unbroken tract 100 miles by 25 miles. To help make these lands entirely Canadian Pacific property the company purchased about 101,000 acres from the Hudson's Bay Company. The entire block was situated between the Red Deer and Bow Rivers and extended from the eastern boundary of Range 11, west of the 4th meridian, to the 5th meridian running in the vicinity of Calgary. This area was considerably larger than the whole of the State of Connecticut.

The country farther south in what is now the province of Alberta was soon undergoing intensive examination. In each season from 1894 to 1897 A. O. Wheeler (1860-1945) headed irrigation survey parties into that part of Canada. The first of these annual investigations covered the period from mid-June to the end of October and moved in the high benchland skirting the foothills as far south as the international boundary. The line of levels followed township outlines previously established under the Dominion Lands Survey System in order to obtain an estimate of the volume of water available for irrigating the plains to the east, as well as to discover facilities afforded by the nature of the topography for carrying the water supply to points of distribution.[6] By following this procedure the need for triangulation was avoided and instead an accurate base of reference, extending in a network over the country, was permanently established on the ground. On both sides of the line of levels the topography necessary to the compilation of a map was obtained, the operations of the topographers being regulated by the speed with which the levelling party advanced. The average rate of progress was 3½ miles a day. Instruments used included a vernier pocket compass with tripod, pocket prismatic compasses, a 4-inch Troughton and Simms transit and a Chesterman steel band, 66-foot chain. An odometer attached to a buckboard as well as pacing were used to check distances traversed. For vertical measurements an 18-inch Y level with a 17-foot telescope rod were employed. Profiles of these lines, with sea level as datum, were plotted as work progressed. All other elevations were obtained by aneroid barometer readings.

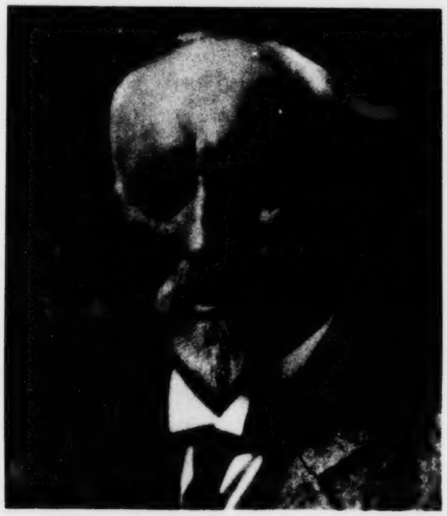


FIGURE 46
A. O. Wheeler.

Dennis, early in 1895, was placed in charge of irrigation surveys and the administration of provisions of the newly-passed federal irrigation legislation. "I left Ottawa on the 16 May", he reported later, "and immediately on my arrival in Calgary I opened my office in a vacant room in the Government block which I had occupied during the previous season and made it known that I was prepared to deal with applications for water rights under the Irrigation Act. . . ".[7] The wisdom of opening such an agency was soon made apparent by the large number of applications and inquiries received. In September, 1895, Dennis, along with Burgess and Pearce, attended sessions of the Fourth International Irrigation Congress at Albuquerque, New Mexico. At that convention Dennis presented an address of consequence on the subject of Canadian irrigation laws and administration.

In the 1895 field season a radical change was made in the operations of Wheeler's survey party. It was decided to conduct these surveys in such a manner as to obtain a reliable concept of the topography and hydrography of the region. To that end work was commenced on a general trigonometrical survey. This task was continued in the two following seasons. In 1897 the survey operation lasted from mid-May to early October. Wheeler headed a party of 8 men, equipped with horses and buckboards. Instructions from Dennis called for a continuation of triangulation as well as of photographic surveys on the eastern slopes of the

Rocky Mountains south of Calgary.[8] "You will continue the work . . . of locating suitable points for the creation of reservoirs at the heads of the streams . . . the map to accompany each report being prepared from your photographic survey of such locations . . . you will make the usual gauging of all streams, confining your work to determination of actual discharges at date of measurement."

A camera and transit theodolite were not received, however, by the Wheeler party until the end of July, by which time the micrometer traverses of Jumpingpound Creek and Elbow River had been completed. The photographic survey was extended eastward sufficiently to cover elevations coming within the contour interval of the proposed final topographic map. It was at first intended to construct the map with 100-foot contour intervals but it was found that this interval was too wide and that the ground configuration was better suited to a 50-foot interval. A tie-in was made at the mouth of the Bow River Pass with the Rocky Mountain region photographic survey by J. J. McArthur. During the early part of the 1897 season smoke haze from forest fires proved troublesome, obscuring the landscape.

During these surveys Wheeler stated that he found settlers in the area traversed greatly distressed over the very high mortality rate among the cattle in the region. They thought the deaths were due to the eating of some kind of poisonous weed. Wheeler's representations to Ottawa in this regard resulted in the speedy despatch of Professor Macoun, then in Calgary, to the scene. Macoun soon traced the poisonings to a plant bearing the name, Rocky Mountain larkspur. The toxic juices in its shoots became most virulent following the first rains of spring.

In 1897 George G. Anderson, an irrigation engineer from Denver, was engaged to report to the Alberta Railway and Irrigation Company on the feasibility and cost of a system of irrigation to serve company lands. He encouraged the proposition of diverting water for this purpose from St. Mary's River. In the following years Mormon settlers, under Anderson's direction, worked to build such a system. Irrigation water reached Lethbridge on July 4, 1900. Earlier it had already been brought to the smaller communities of Sterling and Magrath. Two years later the Canadian Pacific Railway Company opened a headquarters establishment in Calgary to supervise irrigation activities and appointed Dennis in charge as Superintendent of Irrigation. Thus after more than a quarter of a century, most of that period in the employ of the Department of the Interior, the son of confederated Canada's first Surveyor General began a new career with the railway company, a connection that was destined to continue for another 28 years. The company could not have recruited a more experienced or more able man to prosecute the great task allotted to him. Before long he had become assistant to the Second Vice-President of the Canadian Pacific Railway. In 1904 Pearce followed the example of Dennis and left the government service to join the Canadian Pacific Railway organization in connection with administration of irrigated and other lands owned by it.

For administrative purposes the entire Canadian Pacific Railway dry-land domain was divided into three districts, Eastern, Central and Western. Dennis, in his policy-making role with the company, was responsible for many innovations in the realm of irrigation and agriculture in general. He promoted the idea of crop payments in the settlement of land purchases; he energetically supported the cause of livestock improvement and initiated the practice of a touring train devoted to encouraging the production of better stock and poultry. He brought about the first meeting, in July, 1912, at Winnipeg, of the federal Minister of Agriculture and the ministers of agriculture from the three prairie provinces along with leading men of the business world. They were brought together to discuss and study means of improving livestock in the West. Dennis was also a strong and unwavering driving force behind Canadian Pacific Railway colonization and publicity programs.

Dennis never forgot that the Canadian Pacific Railway in its colonization efforts was not so much interested in profits, important as these were to its enterprise, as in people. He was quick to realize that without people there could be no real profits. By 1912, in his unique role of assistant to Canadian Pacific Railway President Shaughnessy, Dennis had risen as well to the position of administrator responsible for the operations of the newly-created Canadian Pacific Railway Department of Natural Resources, located at Calgary. Over the years he made this agency into one of the most active and productive publicity and sales projects in the entire history of the railway.

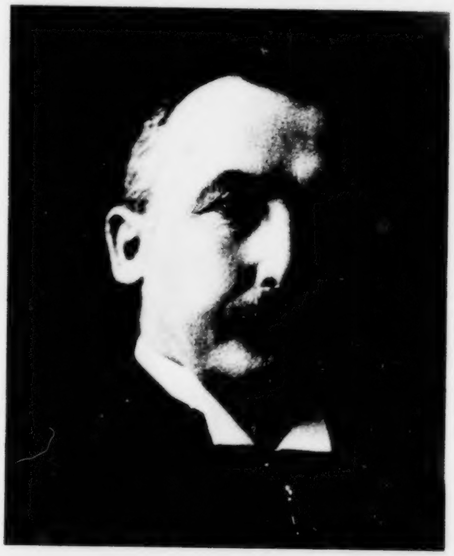


FIGURE 47
Hon. Clifford Sifton.

In 1896 Hon. Clifford Sifton, newly-arrived Minister of the Interior in the Laurier cabinet formed in that year, agreed to the consolidation of the land holdings of the Alberta Railway and Irrigation Company (A.R.I.C.) in one compact block. This, as in the prior case of the Canadian Pacific Railway, was in the interests of more efficient administration. By the first of January, 1908, the Canadian Pacific Railway had absorbed the Canadian Pacific Irrigation and Colonization Company (C.P.I.C.) and by 1912 it had also taken over the A.R.I.C. In the meantime, in 1909, the Canada Land and Irrigation Company (C.L.I.C.) commenced construction of canals in a project designed to serve some 46,000 acres east of Vauxhall. With the advent of the First World War financial difficulties were encountered and progress impeded. Nevertheless by 1927 some 15,000 acres were "under the ditch" in the C.L.I.C. scheme.

During the first quarter of the present century nine separate irrigation districts were established in Alberta, sanctioned by the provincial legislature. This arrangement enabled irrigation farmers to co-operatively finance their operations. Nearly all these districts were formed on the basis of surveys and reports by the Dominion Reclamation Service. Although not the first one to come into being, the Lethbridge Northern Irrigation District, created in 1919 and expanded somewhat in the following year, covered the largest area of any.

Irrigation has proved to be an immense boon to a large and important segment of Western Canada. The growth, prosperity and promise of the light-rainfall region of Southern Alberta,

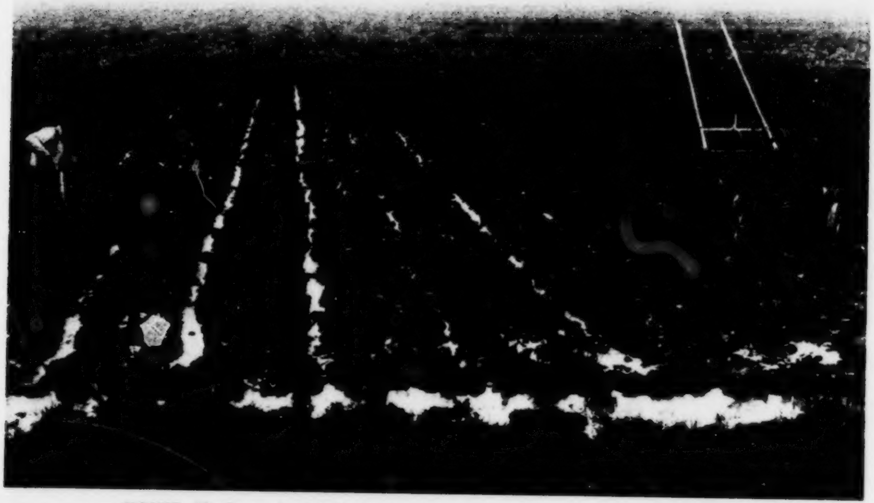
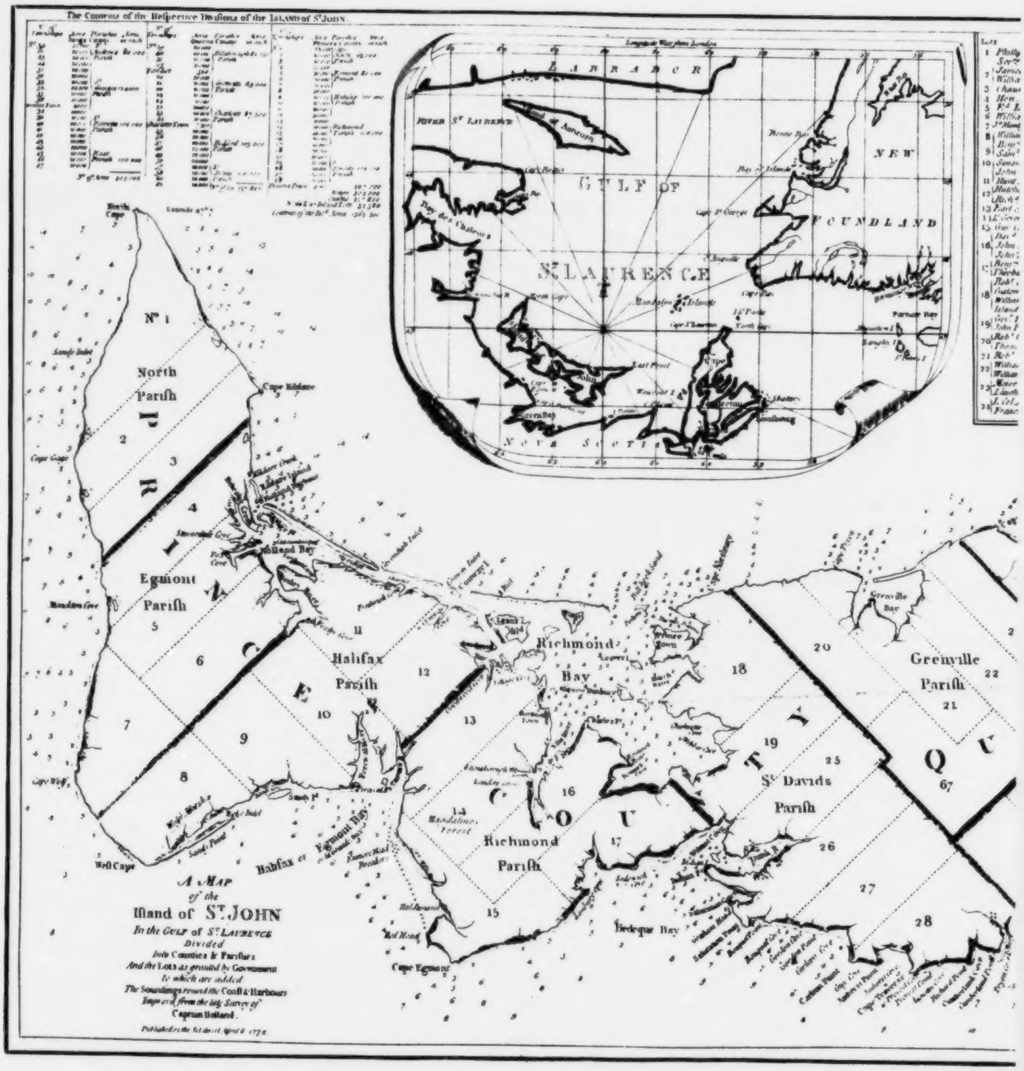


FIGURE 48. Sugar beet field, Galt Irrigation Canal System, Raymond, Alberta.

as well as areas in Saskatchewan and interior British Columbia, are founded on the faith and works of indomitable Canadian land surveyors. These pioneers of the transit and survey camera were men of public spirit as well as of technical ability. Today more than a million acres are "under the ditch" in Alberta with another million acres eventually to be served by irrigation projects in that province. Lesser areas are being brought into vigorous production in the same way in the adjoining provinces.[9] Giant programs of water storage and distribution now nearing completion on the South Saskatchewan and Columbia rivers will doubtless substantially increase those acreage totals.

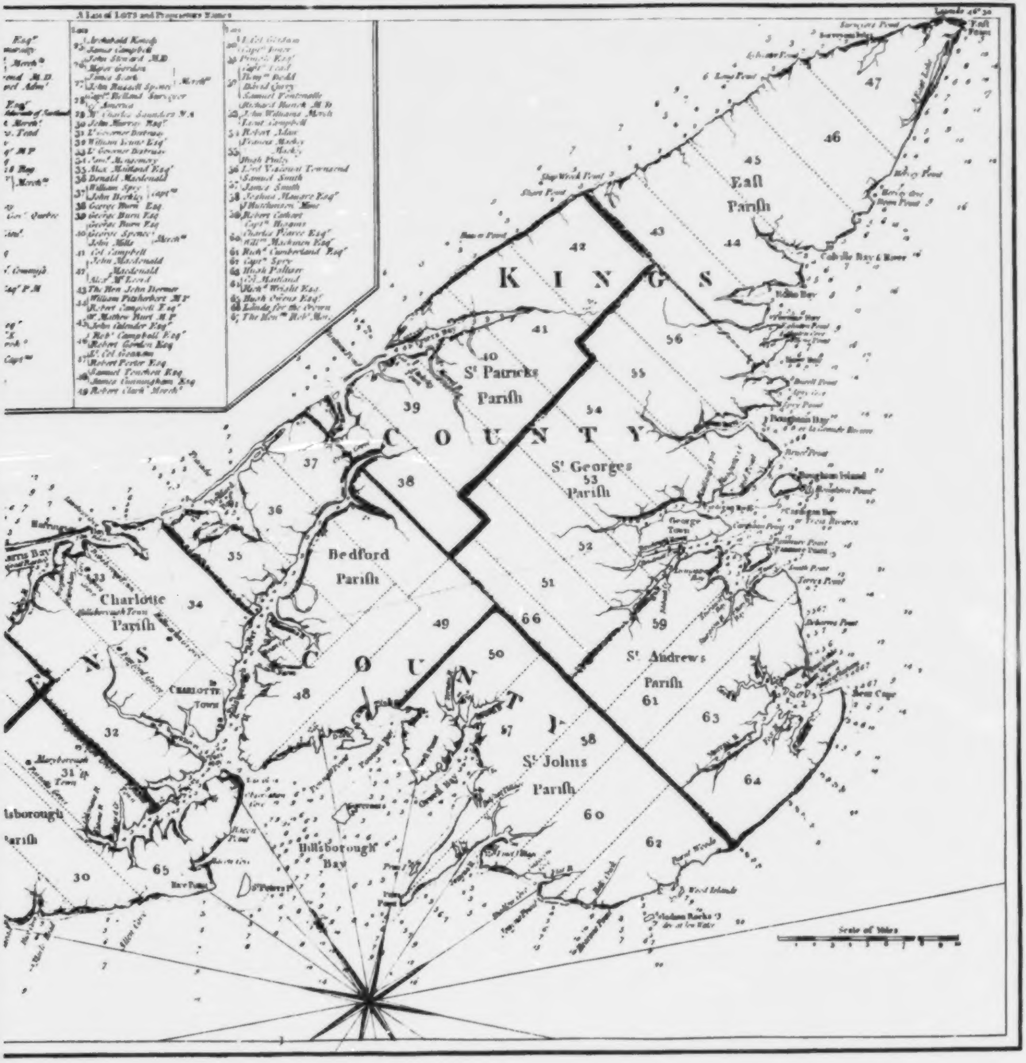
Most prominent in this field of activity in the earliest days of its growth were Dennis, Pearce, Wheeler and Magrath. Dennis may well be called the father of the first Canadian legislation on which, strengthened by subsequent amendments, the entire superstructure of irrigation projects in this nation have been developed. He was also, as we have observed, an administrator of unusual vision and resourcefulness. Pearce must be regarded as a close rival of Dennis for the honor of being the prime instigator of irrigation in Canada. His exploratory surveys and statesmanlike reports on the practical possibilities of Canadian irrigation were of key importance in its wise development. His confidence was boundless in the dynamic future of the areas irrigation could improve. Wheeler's indispensable surveys along the eastern slopes of the Rocky Mountains, south from Calgary, gave valuable and reliable guidance to subsequent expansion of irrigation facilities. Magrath's services as surveyor to the Alberta Railway and Irrigation Company were notable and his memory is perpetuated in the name of the town of Magrath, some 20 miles south of Lethbridge.

In the final analysis, therefore, credit for the conversion of large areas of southern Alberta, otherwise suitable for grazing only, into productive farmlands by the provision of irrigation, is largely due to the vision, foresight and constructive action of Dominion land surveyors.


The Contents of the Respective Divisions of the Island of St. John
A Map of the Island of St. John
In the Gulf of St. Laurence
Divided
Into Counties & Parishes
And the Lots as granted by Government
to which are added
The Soundings round the Coast & Harbours
Improved from the late Survey of
Captain Holland.
Gulf of St. Laurence
Labrador
New Foundland
Nova Scotia
North Cape
Cape Kildare
Cape Egmont
West Cape
North Parish
Egmont Parish
Halifax Parish
Richmond Bay
Richmond Parish
St. Davids Parish
Grenville Parish
Grenville Bay
Bedeque Bay
Egmont Bay
Prince
County
Q U

MAP 6. Captain Holland's map of the Island

XIII


A List of LOTS and Proprietors Names
KINGS COUNTY
East Parish
St Patricks Parish
St Georges Parish
George Town
Bedford Parish
Charlotte Parish
CHARLOTTE TOWN
St Andrews Parish
St Johns Parish
Hillsborough Bay
Hillsborough Parish
Scale of Miles

. John (Prince Edward Island), published in 1775.

7

MAPPING AND MAP MAKING IN CANADA 1867-1917

"I see, as in a map, the end of all . . ."
King Richard III, Act 2, Sc. 4

In the first half-century following Confederation the progress of mapping and map making in Canada reflected the response of a young, dynamic, expanding nation to pressures generated by the possession of a vast, thinly populated and largely unorganized territory richly endowed with natural resources awaiting vigorous development.

Hearne and Mackenzie, in the latter part of the 18th century, had extended the map of Canada northward to the shores of the Arctic Ocean at the mouths of the Coppermine and Mackenzie rivers. But the remainder of the Arctic coastline of this country was not to be more or less fully mapped until the half-way mark in the following century, following the government-supported British expeditions including those of Parry, Franklin, Richardson, Beechey and Rae. The North Pacific coast had been charted by Cook and Vancouver, by the latter in considerable detail. Much later the Corps of Royal Engineers, following up on David Thompson's exploratory surveys and mapping, had added substantially to cartographic knowledge of the southern interior of British Columbia.

In central Canada Robert de Villeneuve's 1688 map of the vicinity of the settlement at Quebec foreshadowed the appearance of the excellent topographic maps of the Murray Atlas, ordered in 1760 to be compiled. These sheets, in turn, were forerunners of the series of mile-to-the-inch maps of strategically important areas in Canada prepared in the 1860s by the Quartermaster General's Department, spurred by false alarms of American military invasion. Shortly after the turn of the century fresh impetus was given to military mapping in Canada for national defence purposes.

In the Maritimes the early chart-making activities of DesBarres and Cook as well as land mapping by Holland and, subsequently, by international boundary surveyors, contributed greatly to cartographical knowledge of the Atlantic provinces and their coastal waters. In the western interior, soon after Confederation, Dominion land surveyors commenced to produce topographic maps that were more detailed and more accurate than any previous cartography representing the high plains. In the days of early exploration, both east and west, travelways such as Indian trails, canoe routes and buffalo trails exerted a distinctively Canadian influence upon map construction in this country.

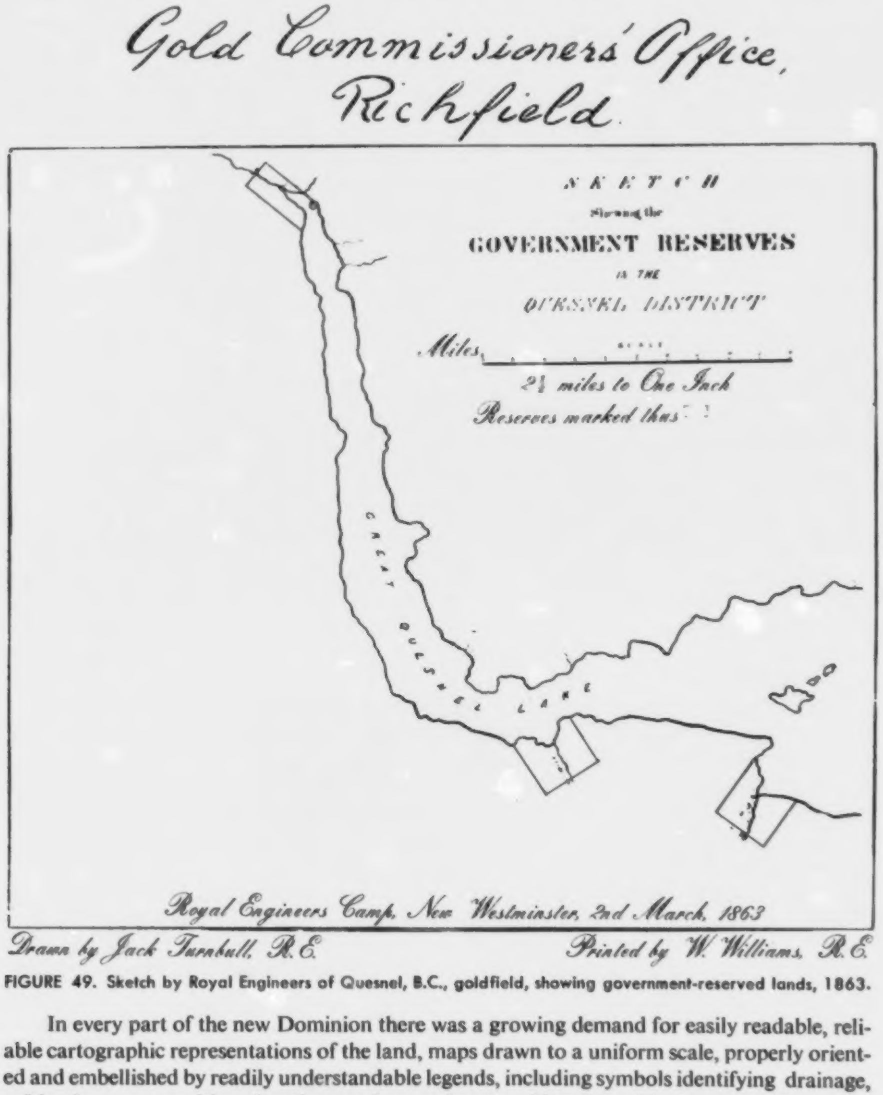

Gold Commissioners' Office, Richfield.
SKETCH
Shewing the
GOVERNMENT RESERVES
IN THE
QUESNEL DISTRICT
Miles
SCALE
2½ miles to One Inch
Reserves marked thus
GREAT QUESNEL LAKE
Royal Engineers Camp, New Westminster, 2nd March, 1863
Drawn by Jack Turnbull, R.E.
Printed by W. Williams, R.E.

FIGURE 49. Sketch by Royal Engineers of Quesnel, B.C., goldfield, showing government-reserved lands, 1863.

In every part of the new Dominion there was a growing demand for easily readable, reliable cartographic representations of the land, maps drawn to a uniform scale, properly oriented and embellished by readily understandable legends, including symbols identifying drainage, cultivation, communities, elevations and ground cover. Maps issued in Canada in the period 1867 to 1917, when considered together, constitute a visible, graphic record of Canada's development during the first half-century of its nationhood. These portrayals on paper reveal the swiftness with which settlement and communications expanded westward across northern Ontario to span the wide prairies and, after penetrating the massive mountain barrier, to make contact with progressive communities in British Columbia. Maps were required to meet the needs of railway building, land settlement, irrigation and reclamation, road construction, power developments and general engineering projects as well as for boundary delineation and national defence. With the establishment in 1871 of the Astronomical Branch, Department of the Interior, a new source of accurate geographical data for map making came into being.

A variety of factors, political, economic and international, combined to spur mapping and map making from coast to coast in Canada. The fundamental new political fact of Confederation, in itself, provided a marked impetus as did the concomitant policies of railway building and of increasing immigration. Sandford Fleming, in his exploring and engineering activities with the Intercolonial and Canadian Pacific Railways, produced maps not only of immediate usefulness but of long-term value. Surveys of the Railway Belt in British Columbia resulted in the publication of maps descriptive of that area. In addition maps were issued to indicate administrative compartments of the western interior. In 1883, for example, a map of political divisions of the prairie west, on a scale of 50 miles to the inch, was published by Dawson Brothers of Montreal and printed by Bartholomew of Edinburgh, Scotland. Surveys in connection with the marking of boundaries between Canada and the United States as well as between Ontario and Manitoba required the issuance of new maps. Electoral maps were made available to publicize the limits of federal and provincial constituencies. Maps of counties, of postal routes and of Mounted Police stations and patrols came into existence to meet the need for information along these particular lines. Demand grew also for maps as aids in the development of Canada's natural resources of timber and minerals. In the western interior grain soon became the principal agricultural resource and its large-scale production depended to an important extent on a steady inflow of settlers. This process was based, in turn, on satisfactory land surveys and accurate mapping. In 1872 a map was published by the Department of the Interior, Ottawa, showing land surveys completed in Manitoba and the North-West Territories.[1]

County atlases and maps were a homely but highly popular form of cartography in the United States and Canada during the second half of the 19th century. A total of 29 Ontario counties or groups of counties were portrayed in atlas style. But only a few copies of these publications are still in existence, partly because their large size made them awkward to store or to preserve. Most of the atlases appeared in the six-year period, 1875 to 1881. Page and Smith, a Toronto firm, published an atlas of Brant county and one of Wentworth county in 1875. In the following year H. R. Page of Toronto published an atlas of Lincoln and Welland counties combined. In the same year Walker and Miles, also of Toronto, published an atlas of Oxford county.

The name "Beers" in this field of map publishing was a conspicuous, if not dominant, name in the United States during this period. Firms bearing names such as "David G. Beers", "Frederick W. Beers", "J. B. Beers", "Beers, Ellis and Company" flourished in various states. The first atlas of Ontario county, in fact, was issued by J. H. Beers and Company in 1877.[2]

But single-sheet maps of Canadian counties appeared much earlier than any of the atlases. In 1856 the Toronto firm of surveyors, Dennis* and Boulton, produced a map of Bruce county, printed by Sage and Sons, Lithographers, Buffalo, N.Y.[3] Two years later, George C. Tremaine published a map of Brant county. In the early 1860s several maps of

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*J. S. Dennis of this partnership became Surveyor General of Canada.

Carleton county were published, some as a result of surveys by H. F. Walling, C.E. In 1860 Putnam and Walling of Kingston, Ontario, published a map of the United Counties of Frontenac, Lennox and Addington, on a scale of 40 rods to the inch. In 1861 G. C. Tremaine published a map of Durham county. R. W. Hermon's map of Huron county, issued in 1862, was lithographed by W. C. Chewett and Company, Toronto, on a scale of 80 chains to the inch. In 1878 four county maps were published by H. Belden and Company, Toronto.

These atlases and individual maps were, for the most part, embellished by sketches consisting of stylized representations of public buildings, private residences, schools and churches of the period. The atlases were financed by subscribers, sometimes as many as 1,200, whose names appeared in a box on the map face. On some county maps the name of the farm owner was placed in the property space ascribed to him. But the real value of the publications is found in the cartography displayed. Some maps were compiled and drawn from information supplied by private surveys, others were copies from official plans and surveys already in existence. These county maps and atlases, rich in geneological information, have become a most popular type of archival material among students and writers of local histories.

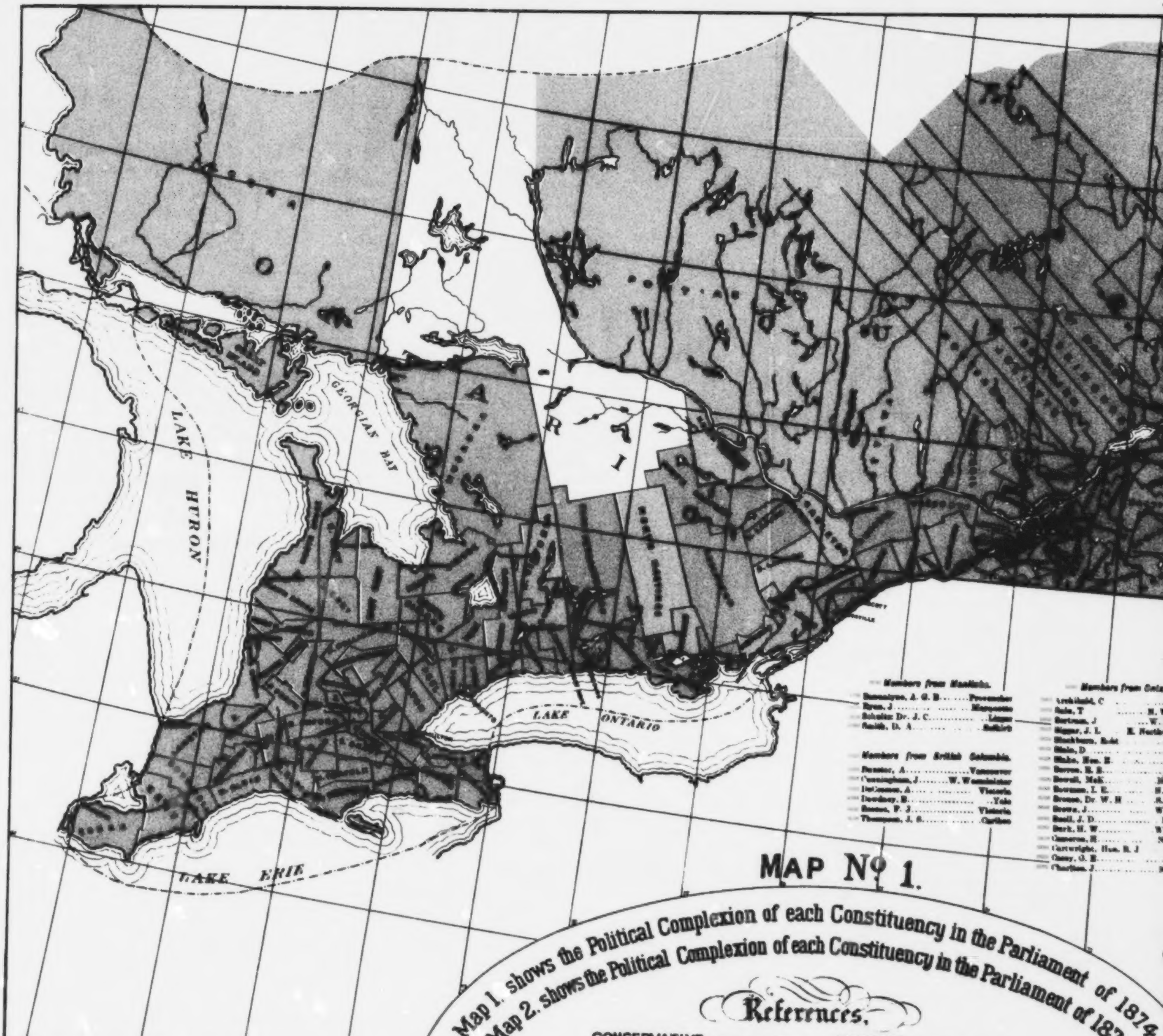
Canadian firms, other than those already mentioned, that were prominently associated in early days with county map designing and publishing included the Ontario partnership of the brothers, G. R. and G. M. Tremaine, also George N. Tackabury of Montreal and the Toronto institutions of Thomas Maclear, and Miles and Company.

Tackabury's Atlas of 1875 and Belden's Illustrated Atlas of 1880 were outstanding Canadian pioneers in the general atlas field. The former volume was printed by the Burland-Desbarats Lithographing Company of Montreal. It had been the intention to publish the Tackabury Atlas in 1871 but the event was postponed in order to include county maps of Quebec. The enlargement of the project entailed much more work than had been anticipated. Available survey plans differed to such an extent in reliability, scales and in details that the compilation of these discordant elements into a harmonious series of maps proved to be, in the words of the editors, "extremely perplexing and difficult".

Postal-route maps appeared in Canada early in the 19th century. These were published by the Post Office Department, Ottawa, to help inform departmental officials on mail distribution arrangements. County and interprovincial boundaries were shown along with post office locations, railway lines and, occasionally, railway stations and road systems. In order to economize on costs and because only a few hundred copies of any one of these maps were required, blueprinting from linen tracings was developed as a process suitable for the purposes. Revisions were required constantly as new post offices were established and new distribution channels created.

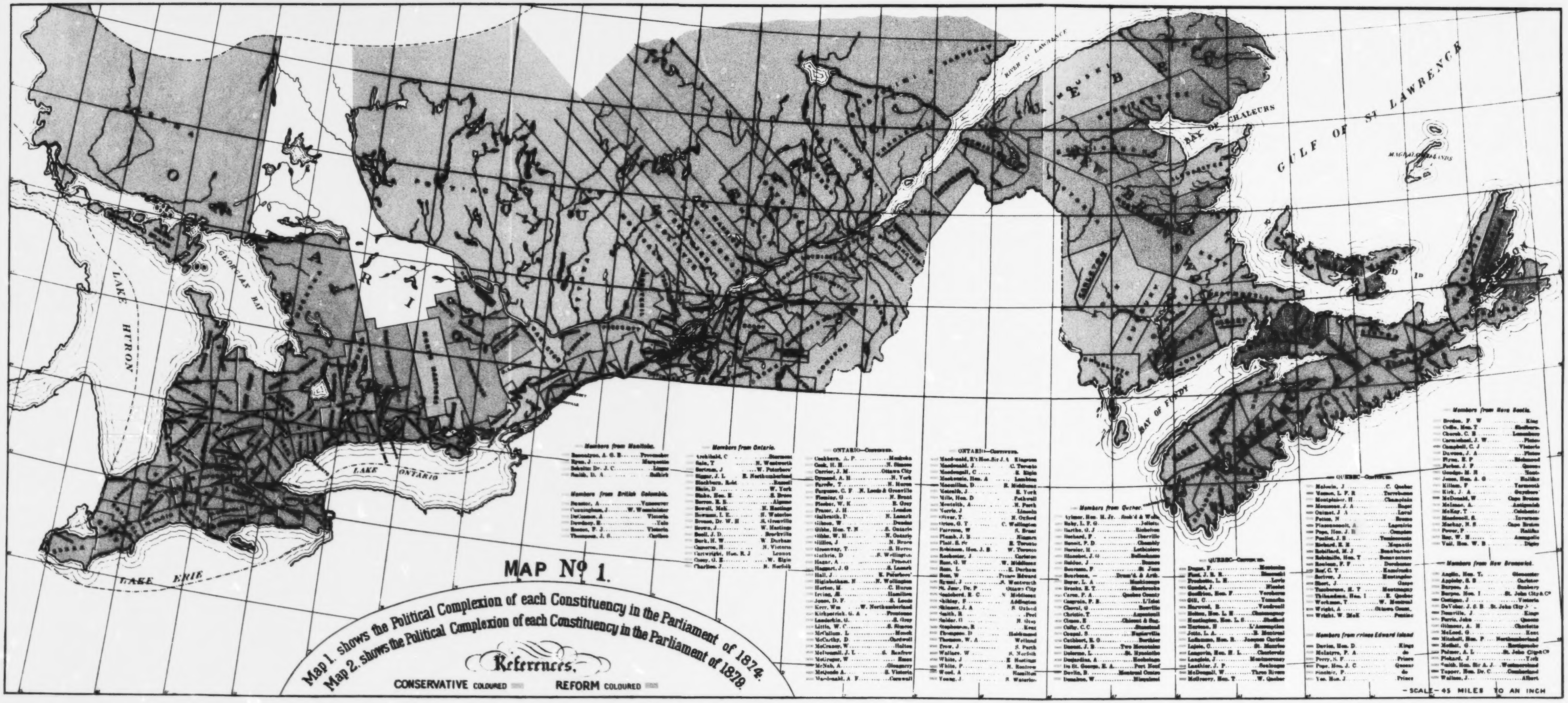
As early as 1832 a map of Upper and Lower Canada, along with parts of New Brunswick and Nova Scotia, was issued by the Post Office Department and bore the name of John Dewe, post office inspector. In 1860 a map of Upper Canada depicting mail routes by dotted lines was published on a scale of 7 miles to the inch by Maclear and Company. In 1916 a 9-sheet map of Ontario and part of Quebec was issued, bearing the name of the chief draughtsman of the department at the time, L. A. (Lefevre Anstruther) Maingy.

The origin of electoral maps in Canada remains obscure but as early as the 1870s privately published atlases and separate map sheets were in circulation in this country for the purpose of showing constituency boundaries. Tackabury's Atlas of 1875 contained a map on a scale of 20 miles to the inch of Ontario showing 88 provincial districts.[4] Four years later William R. Robins designed and published his colorful electoral map No. 1. A green strip opposite a House of Commons member's name denoted, in a map box, a Conservative and red, a Reformer. The map also showed the political complexion of each riding in the 1874



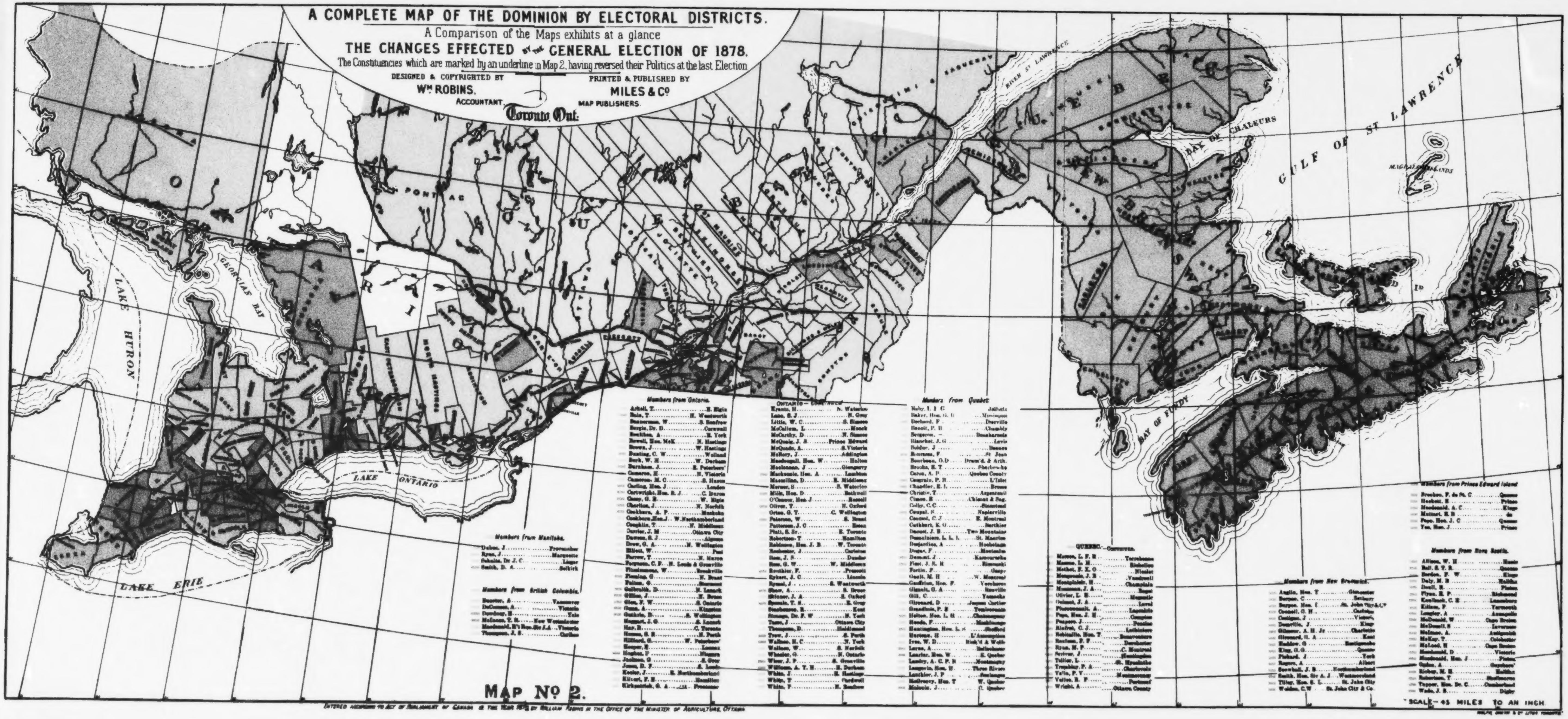
MAP Nº 1.
Map 1. shows the Political Complexion of each Constituency in the Parliament of 1874.
Map 2. shows the Political Complexion of each Constituency in the Parliament of 1878.
References.
CONSERVATIVE COLOURED
REFORM COLOURED
Members from Manitoba.
Bannatyne, A. G. B. .... Provencher
Ryan, J .... Marquette
Schultz Dr. J. C. .... Lisgar
Smith, D. A. .... Selkirk
Members from British Columbia.
Bunster, A .... Vancouver
Cunningham, J .... W. Westminster
DeCosmos, A .... Victoria
Dewdney, E .... Yale
Roscoe, F. J .... Victoria
Thompson, J. S .... Cariboo
Members from Ont
Archibald, C
Bain, T
Bertram, J
Biggar, J. L.
Blackburn, Robt
Blain, D
Blake, Hon. E.
Borron, E. B.
Bowell, MacK.
Bowman, I. E.
Brouse, Dr. W. H
Brown, J
Buell, J. D.
Burk, H. W.
Cameron, H.
Cartwright, Hon. R. J
Casey, G. E.
Charlton, J.
LAKE HURON
GEORGIAN BAY
LAKE ONTARIO
LAKE ERIE
O N T A R I O
Q U E

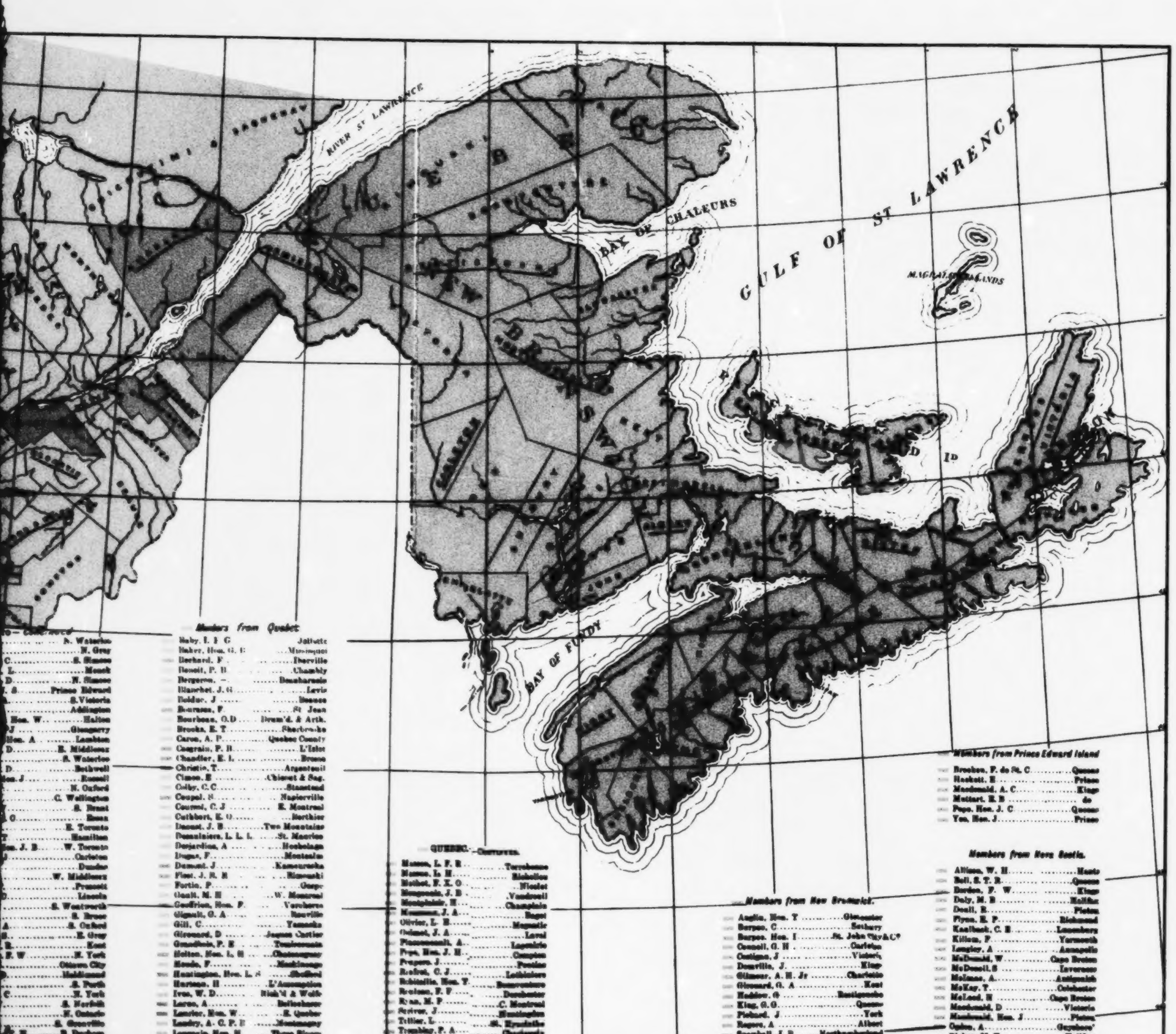
MAP 7. Robins' Politi



MAP No 1.
Map 1. shows the Political Complexion of each Constituency in the Parliament of 1874.
Map 2. shows the Political Complexion of each Constituency in the Parliament of 1878.
References.
CONSERVATIVE COLOURED
REFORM COLOURED
LAKE HURON
GEORGIAN BAY
LAKE ONTARIO
LAKE ERIE
RIVER ST LAWRENCE
BAY OF CHALEURS
GULF OF ST LAWRENCE
MAGDALEN ISLANDS
BAY OF FUNDY
Members from Manitoba.
Members from British Columbia.
Members from Ontario.
ONTARIO—Continued.
Members from Quebec.
QUEBEC—Continued.
Members from Prince Edward Island
Members from Nova Scotia.
Members from New Brunswick.
SCALE—45 MILES TO AN INCH

MAP 7. Robins' Political Chart of Canada, 1879.


A COMPLETE MAP OF THE DOMINION BY ELECTORAL DISTRICTS.
A Comparison of the Maps exhibits at a glance
THE CHANGES EFFECTED BY THE GENERAL ELECTION OF 1878.
The Constituencies which are marked by an underline in Map 2, having reversed their Politics at the last Election
DESIGNED & COPYRIGHTED BY
Wm. ROBINS.
ACCOUNTANT.
PRINTED & PUBLISHED BY
MILES & Co
MAP PUBLISHERS.
Toronto, Ont.
LAKE HURON
GEORGIAN BAY
LAKE ONTARIO
LAKE ERIE
RIVER ST LAWRENCE
GULF OF ST LAWRENCE
BAY OF CHALEURS
BAY OF FUNDY
MAGDALEN ISLANDS
PONTIAC
Members from Ontario.
ONTARIO—CONTINUED.
Members from Quebec.
QUEBEC—CONTINUED.
Members from Manitoba.
Members from British Columbia.
Members from New Brunswick.
Members from Prince Edward Island.
Members from Nova Scotia.
MAP No 2.
SCALE—45 MILES TO AN INCH
ENTERED ACCORDING TO ACT OF PARLIAMENT OF CANADA IN THE YEAR 1878 BY WILLIAM ROBINS IN THE OFFICE OF THE MINISTER OF AGRICULTURE, OTTAWA



O—CONTINUED

	N. Waterloo
	N. Grey
C.	S. Simcoe
L.	Monck
D.	N. Simcoe
J. S.	Prince Edward
A.	S. Victoria
	Addington
Hon. W.	Halton
J	Glengarry
Hon. A.	Lambton
D.	E. Middlesex
	S. Waterloo
D.	Bothwell
on. J	Russell
	N. Oxford
	C. Wellington
	S. Brant
O.	Essex
	E. Toronto
T.	Hamilton
on. J. B.	W. Toronto
	Carleton
	Dundas
	W. Middlesex
	Prescott
	Lincoln
	S. Wentworth
	S. Bruce
A.	S. Oxford
S.	E. Grey
R.	Kent
F. W	N. York
	Ottawa City
	Haldimand
	S. Perth
C.	E. York
	S. Norfolk
	N. Ontario
	S. Grenville
T. H.	E. Durham
	E. Hastings
	Cardwell
	N. Renfrew

Members from Quebec

Baby, L. F. G	Joliette
Baker, Hon. G. B	Missisquoi
Bechard, F	Iberville
Benoit, P. B	Chambly
Bergeron, —	Beauharnois
Blanchet, J. G	Levis
Bolduc, J	Beauce
Bourassa, F	St Jean
Bourbeau, O. D	Drum'd. & Arth.
Brooks, E. T	Sherbrooke
Caron, A. P	Quebec County
Casgrain, P. B	L'Islet
Chandler, E. L	Brome
Christie, T	Argenteuil
Cimon, E	Chicout & Sag.
Colby, C. C	Stanstead
Coupal, N	Napierville
Coursol, C. J	E. Montreal
Cuthbert, E. O	Berthier
Daoust, J. B	Two Mountains
Desaulniers, L. L. L	St. Maurice
Desjardins, A	Hochelaga
Dugas, F	Montcalm
Dumont, J	Kamouraska
Fiset, J. B. R	Rimouski
Fortin, P	Gaspe
Gault, M. H	W. Montreal
Geoffrion, Hon. F.	Vercheres
Gigault, G. A	Rouville
Gill, C	Yamaska
Girouard, D	Jacques Cartier
Grandbois, P. E	Temiscouata
Holton, Hon. L. H	Chateauguay
Houde, F	Maskinonge
Huntington, Hon. L. S	Shefford
Hurteau, H	L'Assomption
Ives, W. D	Rich'd & Wolfe
Larue, A	Bellechasse
Laurier, Hon. W	E. Quebec
Landry, A. C. P. R	Montmagny
Langevin, Hon. H.	Three Rivers
Lanthier, J. P	Soulanges
McGreevy, Hon. T	W. Quebec
Malouin, J	C. Quebec

QUEBEC.—CONTINUED.

Masson, L. F. R	Terrebonne
Massue, L. H	Richelieu
Methot, F. X. O	Nicolet
Mongenais, J. B	Vaudreuil
Montplaisir, H	Champlain
Mousseau, J. A	Bagot
Olivier, L. B	Megantic
Ouimet, J. A	Laval
Pinsonneault, A	Laprairie
Pope, Hon. J. H	Compton
Poupore, J	Pontiac
Rinfret, C. J	Lotbiniere
Robitaille, Hon. T.	Bonaventure
Rouleau, F. F	Dorchester
Ryan, M. P	C. Montreal
Scriver, J	Huntingdon
Tellier, L	St. Hyacinthe
Tremblay, P. A	Charlevoix
Valin, P. V	Montmorency
Vallee, E. P	Portneuf
Wright, A	Ottawa County

Members from New Brunswick.

Anglin, Hon. T	Gloucester
Burpee, C	Sunbury
Burpee, Hon. I	St. John City & Co
Connell, G. H	Carleton
Costigan, J	Victoria
Domville, J.	Kings
Gillmor, A. H. Jr	Charlotte
Girouard, G. A	Kent
Haddow, G	Restigouche
King, G. G	Queens
Pickard, J	York
Rogers, A	Albert
Snowball, J. B	Northumberland
Smith, Hon. Sir A. J	Westmoreland
Tilley, Hon. S. L	St. John City
Weldon, C. W	St. John City & Co.

Members from Prince Edward Island

Brecken, F. de St. C	Queens
Hackett, E	Prince
Macdonald, A. C	Kings
Muttart, E. B	do
Pope, Hon. J. C	Queens
Yeo, Hon. J	Prince

Members from Nova Scotia.

Allison, W. H	Hants
Bell, S. T. R	Queens
Borden, F. W	Kings
Daly, M. B	Halifax
Doull, R	Pictou
Flynn, E. P	Richmond
Kaulbach, C. E	Lunenburg
Killam, F	Yarmouth
Longley, A	Annapolis
McDonald, W	Cape Breton
McDonnell, S	Inverness
McIsaac, A	Antigonish
McKay, T	Colchester
McLeod, H	Cape Breton
Macdonald, D	Victoria
Macdonald, Hon. J	Pictou
Ogden, A	Guysboro'
Richey, M. H	Halifax
Robertson, T	Shelburne
Tupper, Hon. Dr. C	Cumberland
Wade, J. B	Digby

SCALE—45 MILES TO AN INCH.

ROLPH, SMITH & Co LITHO TORONTO

Parliament. Robins' map No. 2, contained on the same sheet, provided similar information on the Parliament of 1879. The publisher was Miles and Company of Toronto.[5]

Included in the 1880 illustrated atlas published by H. Belden and Company was a map showing federal electoral districts. However, the resemblance of this map to maps of that time showing all the counties, was striking. In 1891 a map was issued under the authority of the then Lieut.-Governor of the North-West Territories and published by the Department of the Interior, showing electoral districts for the Territorial Legislative Assembly. This map, a copy of which is to be found in the Map Division, Public Archives of Canada, Ottawa, also showed railway systems built or projected for the western interior.

The first federal electoral atlas was published at Ottawa in 1895. Queen's Printer S. E. Dawson, in his foreword, deplored the absence until that year, of any suitable Canadian electoral maps. This initial official atlas was patterned along the lines of a New South Wales, Australia, publication. Canadian postal maps were also used as a basis for this project and Mr. Maingy of the Post Office Department assisted in correcting proofs. The maps in this first official atlas in Canada pertained to six provinces, Quebec, Ontario, New Brunswick, Nova Scotia, Prince Edward Island and Manitoba.

FIGURE 50. Typical river conditions facing surveyors at high water. View of survey crew working upriver on Finlay River, B.C.

Maps were issued almost annually from 1886 to 1906 under the title "Mounted Police Stations and Patrols in the North West Territory." In the 1880s these were published under the authority of Prime Minister Sir John A. Macdonald and in 1906, when the word "Patrols" disappeared from the map title, the sheets were published under the authority of Sir Wilfrid Laurier as President of the Council. The 1906 map in this series bore the inscription "James White, Geographer."

Considerable chart production work was being performed in the latter part of the 19th century by the federal Department of Marine and Fisheries through the agency of the Great Lakes Surveys, later re-named the Hydrographic Survey of Canada, and since 1927 known as the Canadian Hydrographic Service. This aspect of mapping will be considered in detail in a chapter on marine charting.

The lack of topographic maps of Canada up to the middle of the 19th century compelled geologists, as has been noted, to study and to practice this type of map making in order to provide themselves with a base sheet on which to convey the geological information they had gathered. This unwelcome but necessary addition to labors already heavy proved costly in time and money. Topographic mapping duties drained away hours and energy that otherwise would have been devoted to geological investigations. Nevertheless early geologists made a highly valuable pioneer contribution to Canadian cartography. A high mark in this regard was reached with the publication in 1866 of Sir William Logan's large geological map of Canada. In 1877 the Geological Survey of Canada published with its report of that year G. M. Dawson's map of the southern interior of British Columbia, one of the first Canadian sheets on which the hachure technique was employed to help depict land forms on paper. Drawn on the scale of 10 miles to the inch this map was one of the first large contributions to geographical knowledge of that part of Canada.[6]

In post-Confederation years mapping developments in the United States had a profound impact upon cartographic progress in Canada. From 1819 to 1843 the rapid increase in population in the American west resulted in increasing demands for road, canal and port surveys in the east. At the same time engineers of the then newly-organized Army Topographic Bureau made large-scale maps of the Gulf of Mexico coast, the Upper Mississippi basin and on the prairies between the Mississippi River and the Rocky Mountains. The acquisition of new lands in the far west and the discovery of gold in California emphasized the need for reliable mapping of transportation routes west of the Rockies.[7] The period 1861-1879 began with the Civil War and the resulting needs of military cartographers spurred notable advances in mapping techniques. With the coming of peace four western land survey projects were undertaken by the War and Interior Departments. In this way more than 600,000 square miles of the western interior of the United States were mapped. With the establishment in 1879 of the United States Geological Survey as the main mapping agency of the federal government, the systematic topographical and geological mapping of the United States was carried forward by a well-trained, competent group of professionals in the field. At that point in history it may be stated that topographic mapping in the United States came of age.

In the 1880s, through the formation of the Canadian Hydrographic Survey along with the creation of a Topographical Surveys Branch, in succession to the Technical Branch in the Department of the Interior, fresh stimulus was given to the growth of Canadian cartography. In 1886 a notable forward stride in land mapping took place when Deville introduced the survey camera in mountainous areas of the Canadian West. This experiment proved eminently successful. In the field survey of 1901 A. O. Wheeler commenced survey camera work in the Selkirk Range. He had been instructed to prepare a map of that region. The Canadian Pacific Railway line was used as a survey base line *pro tem* and a secondary triangulation was undertaken for the purpose of fixing camera stations and locating peaks.

In 1886 Dr. Robert W. Bell, a member of the Geological Survey of Canada caused a flurry in high official circles in Ottawa when a paper he delivered at the Dominion Land Surveyors' Association annual meeting drew attention to some glaring shortcomings in the map-making policies and practices of federal government departments.[8] Dr. Bell pointed out that departments active in the mapping field made no attempt to work on a uniform scale. He urged that a base map common to all departmental cartographic work be adopted. In addition to uniformity of scales and projections he proposed that there be uniformity in map nomenclature. For example he listed variations he had detected in the spelling of Nipigon, namely Nipegon, Neepigon, Neipegon and Nipeegon.

Bell advocated as well the establishment of a central map bureau in Ottawa, a place where cartographic information from all government sources could be pooled for reference purposes. He pressed for a proper trigonometrical survey of all Canada and emphasized that unless such a survey was made it would be impossible to map correctly even the well-known tract between Lakes Huron, Erie and Ontario. This probability had come to Bell's attention while he had been preparing a geological map of that region. When all existing survey plans of large townships had been placed together he discovered these could not be made to fit into one another or into the represented space between the lakes. Rail lines would not cut township survey lines where they ought to do and townships would not conform to the lakeshores as laid down in charts, no matter what system of projection was employed.

The stir caused by this surprise attack resulted in the appointment by the Association of a standing committee of two experts, W. F. King and Robert Bell himself, to inquire into the best means of applying a uniform system of map making in the various federal agencies most concerned. The committee report was not optimistic over prospects for standardization.[9] The departments mainly involved were Public Works, Railways and Canals, and Interior. The latter department possessed two organizations engaged in topographical mapping, the Technical Branch and the Geological Survey. Other departments in Ottawa produced maps and charts but in a relatively minor way. These were the Post Office, Marine and Fisheries, Agriculture and Indian Affairs Departments.

It was found by the standing committee that surveys by Public Works and by Railways and Canals were usually undertaken in connection with engineering projects in which basic measurements were made by a 100-foot chain. Accordingly, plans of those departments were constructed on scales representing multiples of 100 feet, that is, 200, 300 or 2,000 feet to the inch. On the other hand, in standard land surveys under the Interior Department, 66-foot chains were employed. Thus for larger maps the 6-miles-to-the-inch scale was used, or some multiple thereof, as this was the natural scale for the 6-mile-square township. Moreover the use of that scale in the western interior made it possible for map makers to put the whole width between two successive initial meridians on one sheet of convenient size.

In exploratory surveys of the Geological Survey of Canada the unit of measurement was one mile. In constructing his earliest maps Logan consulted maps of Crown Land surveys, Admiralty charts, rail surveys, county maps produced by private enterprise, military maps and hydraulic surveys. The scale that Logan adopted for his special purposes was that of 4 miles to the inch or multiples thereof. On the whole the committee was compelled to conclude that only the scales used by the Geological Survey and the Dominion Lands Branch were conformable and that it was practically impossible to adopt any uniform scale to mapping done by other federal departments or agencies. Each department, having its own special purposes to serve, selected the scale best suited to the accomplishment of its objective.

In March, 1886, Thomas Fawcett, as president of the Dominion Land Surveyors' Association, addressed a memorial to the Minister of the Interior on behalf of that organization. He cited the mapping activities and advances of various European nations and the United States and pointed out that all of these were based on triangulation surveys. He advocated the immediate establishment of a chain of primary triangulation along the St. Lawrence River from the Gulf to the Great Lakes, a system that would provide a foundation for the extension of surveys into the western interior and which could be readily connected up with existing nets of the United States Lake Survey, conducted by the Corps of Engineers, United States Army.

Up until 1889 maps issued by the Technical Branch, Department of the Interior, Ottawa, depicted the progress of surveys and settlement on the western plains. These maps bore three color tints to portray land that had been patented, land entered upon by settlers but not yet patented, and land reserved from settlement. Each map sheet showed an area of about 50 by 80 miles and was drawn on the scale of three miles to the inch. Such maps were founded on various sources of information: official Dominion land surveys, locations of railways and railway stations, post offices, Indian Reserves, forest reserves, federal parks as well as roads and trails. Latitudes and longitudes were given to minutes, altitudes in feet above sea level. Sheets were numbered to a regular pattern and each sheet was named after some important community or physical feature contained within the area covered. In the spring of 1890 a map of Manitoba and the North-West Territories was prepared by the Department of the Interior for display at the Bremen (Germany) Exhibition. The purpose was to illustrate the development of Canada's natural resources, especially agriculture. The map excited considerable interest.

FIGURE 51
J. E. Chalifour.

In the spring of 1892 Deville reported that "a map of the Railway Belt in British Columbia, on a scale of 3 miles to the inch, had been completed and printed in 8 sheets. A small map of the North West Territories, showing electoral districts, was prepared for photo-lithography. Mr. Johnson was supplied with information for a new edition of the large map of Manitoba and the North West."

James White (1863-1928), who came to be acknowledged as a prominent Canadian geographer of his day, began his career with the Geological Survey of Canada in 1884 as an assistant topographer. Born in Ingersoll, Ontario, White graduated from Royal Military College, Kingston, at the age of 20. During the following 10 years he served on field parties in central Canada and with G. M. Dawson in the Rocky Mountains. In June, 1894, he succeeded Robert Barlow, officer in charge of topographic work for the organization. White continued as a geographer and chief draughtsman in the Geological Survey until June, 1899, when he was appointed Geographer (later, Chief Geographer) in the Department of the Interior. He held this position until 1910 when he became secretary to the federal Conservation Commission. James White became a specialist in boundary questions and wrote prolifically in this field and on matters related to the geography of his country.[10] His most important contribution to Canadian cartography was his *Atlas of Canada*, the first edition of which was published in 1906. This work was revised and enlarged in 1915 by Joseph Epiphane Chalifour (1863-1953), a successor to White in the post of Chief Geographer. Born in Rimouski, Quebec, Chalifour came to Ottawa in 1881. He entered the federal civil service in 1884 and continued in map-making work until his retirement in 1931. The Roquette Gold Medal of the Geographical Society of France was awarded to White and Chalifour as co-authors of these early federal government atlases of this country.

White left a fairly complete record of topographical map-making work by Canadian geologists from 1842 to 1896.[11] For example, White referred to the general reconnaissance made in 1877 by G. M. Dawson in the southern interior of British Columbia. "The geological intricacies of the region", he pointed out, "necessitated the doubling of the scale of the original map [of the area] and, consequently the re-delineation of the topography." There was a re-survey in 1888-90 by Dawson and his topographical assistant, James McEvoy. A loose network of triangulation, based on the Canadian Pacific Railway line and other surveyed lines, was constructed between points, and elevations determined barometrically. Other details of topography were filled in from paced and track surveys checked by latitude observations. The topographical mapping work of Sir William Logan, Murray, Richardson, Low, Bell, Selwyn, Tyrrell and McConnell was also described by White in his writings in considerable detail.

Mount White, on the upper Red Deer River in Alberta, was named by Dawson in honor of his former field assistant whose subsequent surveying, mapping and writing added significantly to the general fund of knowledge of Canada's geography. In 1899 Hon. Clifford Sifton authorized White to commence compilation of a new map of Canada, excluding the northern islands, in eight sheets on a scale of 35 miles to the inch. This was published in 1903. When that task was completed a series of topographic maps of the more settled parts of Canada was undertaken in the same year. Some of these maps were on a scale of 1:500,000 (7.89 miles to the inch) but most were 1:250,000 (3.97 miles to the inch). White observed that as these maps were engraved on copper plates, corrections of them could be made from time to time by hammering out from the back of the plate, then re-surfacing the work side of the plate.[12]

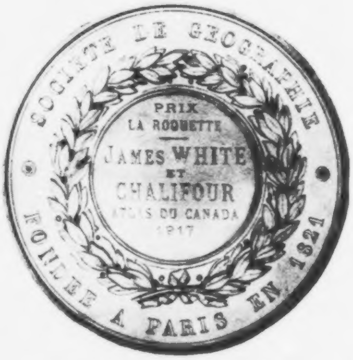


FIGURE 52
Reverse of French medal given to James White and J. E. Chalifour, 1917.

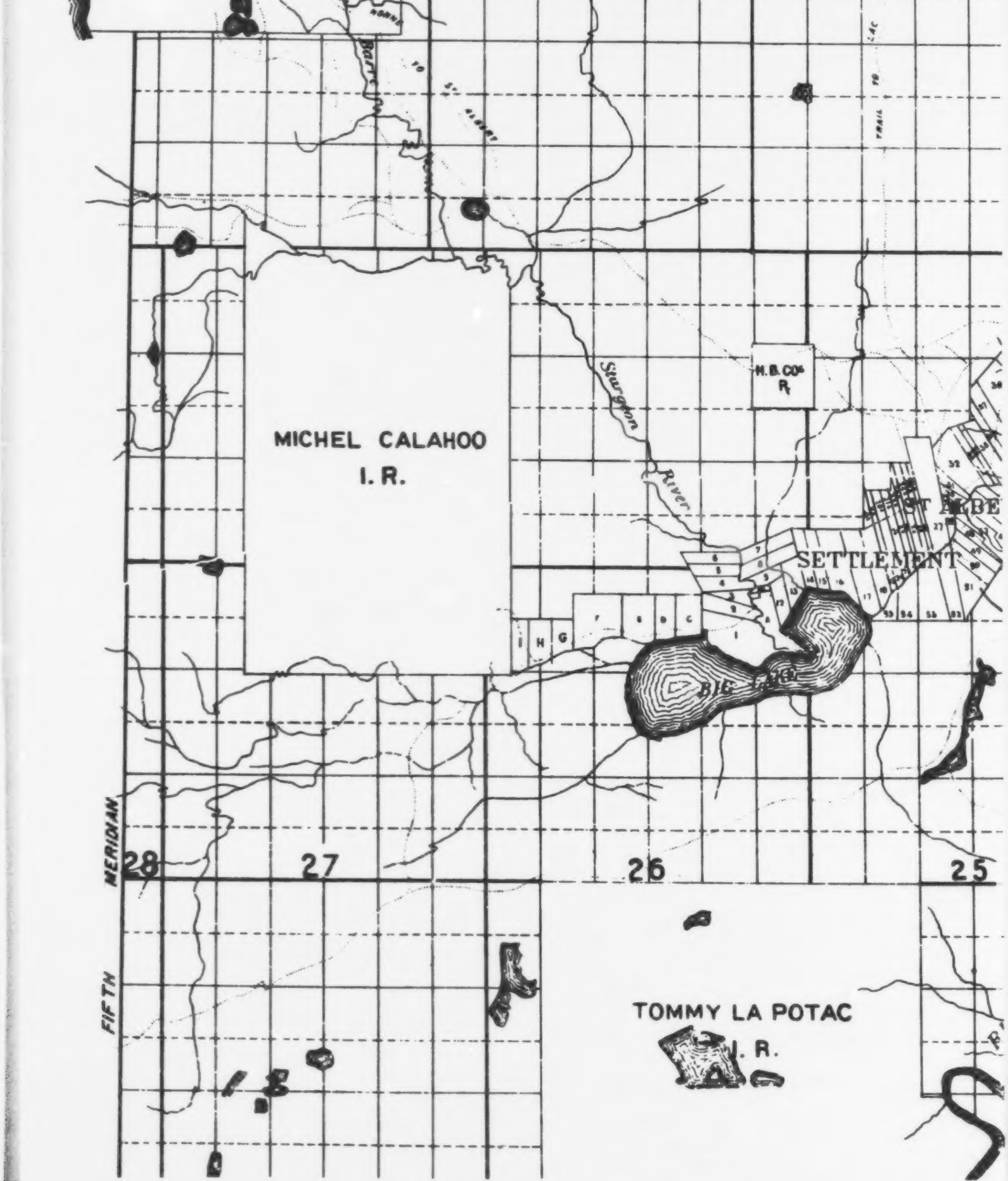
From 1890 to 1920 annual reports of the Surveyor General of Canada reveal a steady growth in government mapping work carried out under his authority and direction. In 1890 the Topographical Surveys Branch, Department of the Interior, produced 49 map sheets and printed 5,640 impressions. By 1909 these production totals had increased to 93 map sheets and 139,850 impressions. The staff of the mapping section of the Branch, scattered about Ottawa in four downtown office buildings, had grown to 51 men, headed by a chief draughtsman. Four of the staff specialized in compiling sectional maps.

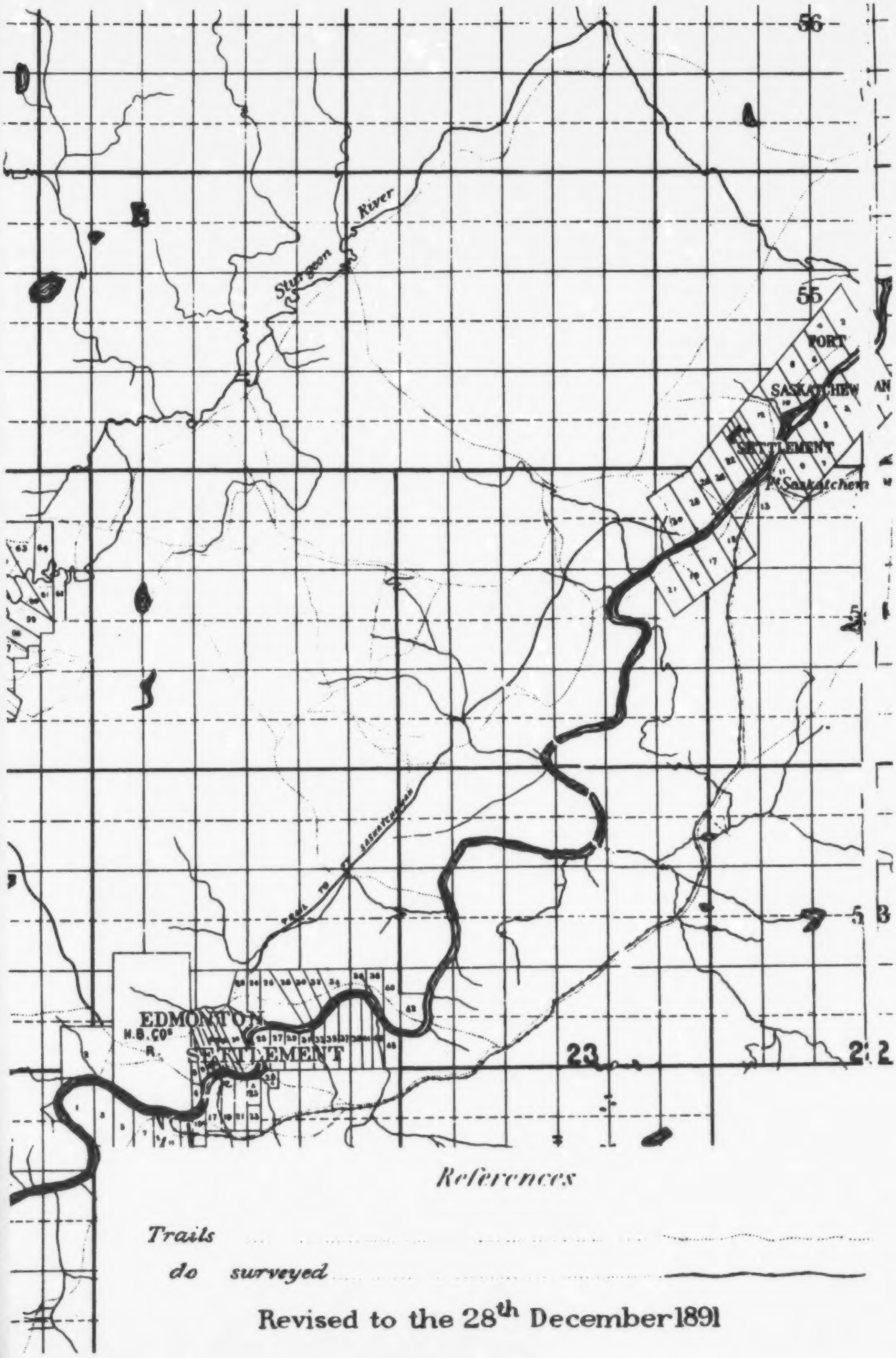
But this generally cheerful picture was not without some blemishes. In his 1904-05 report Deputy Minister Cory of the Interior Department sounded a critical note when he stated that "existing maps of Canada, to a large extent, are based on imperfect surveys or upon surveys that, while individually accurate, are not properly coordinated. In mapping, when these surveys are joined to one another, errors tend to accumulate until serious discrepancies appear: the individual pieces of the map can no longer be fitted together without an adjustment." Cory seemed to echo Bell's complaint made almost a score of years earlier. The need for a more accurate basis for topographic mapping, emphasized by Thomas Fawcett in 1886, became more and more apparent. Early in 1905 the federal government decided that triangulation surveys should commence in the more settled parts of central Canada. Accordingly, in that year Chief Astronomer King was authorized to establish near Ottawa the point of commencement of such a system. Four years later the Geodetic Survey of Canada came into being.

Mapping work in the Department of the Interior was carried on, after 1873, in the Technical Branch, directly under the Surveyor General. On July 5, 1890, this organization became known as the Topographical Surveys Branch and this title persisted until 1922 when it changed to the Topographical Survey of Canada. By adopting this title a clearer line was drawn between federal government surveys on the one hand and provincial government or private enterprise surveys on the other. A rival federal government organization functioned under a similar title, namely, the Topographical Surveys Division of the Geological Survey of Canada. In order to relieve individual geologists of the growing burden of topographical map making, it was decided at policy-making levels in 1908 to form a new division under Walter Halcro Boyd (1878-1960) as its first Topographical Engineer. Nearly three decades were to pass before the two main civilian mapping organizations became one. But at the time this step represented a notable advance. For the first time mapping and map-making functions of the Geological Survey of Canada were organized as a separate unit and the work undertaken by a corps of men trained in map making rather than as geologists. High standards of work were observed and mapping placed on a more systematic basis, generally utilizing the mile-to-the-inch scale on a sheet covering either 30 minutes of longitude and 15 minutes of latitude or 15 by 15.

FIGURE 53
W. H. Boyd.

A third parallel but less competitive government organization was the Mapping Department of the Intelligence Division at Canadian Militia Headquarters, Ottawa. The organization of this Division was completed in November, 1904, and part of the task of collecting intelligence was the procuring of reliable military maps.[13] Previously, small areas of Ontario and Quebec lying along the International Boundary had been surveyed by army surveyors in


ALEXANDER
I. R.
Rivière Qui Barre
TRAIL FROM LAC STE ANNE TO ST ALBERT
TRAIL TO LAC LA BICHE
MICHEL CALAHOO
I. R.
Sturgeon River
H.B.Co's
R.
ST ALBE
SETTLEMENT
BIG LAKE
I H G F E D C
FIFTH MERIDIAN
28
27
26
25
TOMMY LA POTAC
I. R.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PORT
SASKATCHEW
SETTLEMENT
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23
References
Trails
do surveyed
Revised to the 28th December 1891

he federal government's Sectional Map Series. Scale: 3 miles to the inch.

1904 and maps with contours on a scale of a mile to the inch had been constructed, to be lithographed early in the following year. The British War Office loaned, by arrangement, six non-commissioned officers of the Royal Engineers trained in surveying to the Mapping Department. In 1909 this title was changed to Survey Division and, in 1926, to the Geographical Section, General Staff. In time this unit developed into Army Survey Establishment, Royal Canadian Engineers, Department of National Defence. As a complete photomechanical and lithographic section had been established at Ottawa for military mapping purposes in Ottawa as early as 1914, there was no need after that date to send map manuscripts to Ordnance Survey in England for reproduction.

During the years of rapid settlement of the western interior, maps of that region were difficult to keep up to date. Successive revised editions had to be printed. Sometimes so many revisions were required, an entirely new drawing had to be made. After 1905 zinc plates gradually replaced the use of stones in the printing of map engravings, partly because the plates were much more easily stored and because of the development of photo-mechanical processes. By 1916-17 some 128 sectional map sheets had been published covering about 500,000 square miles of Canada. An index map of Dominion land surveys was included in the departmental report of that fiscal year. In 1918-19 a change was made in the method of producing original drawings for sectional maps. Information on township plans was stamped with printer's type rather than by hand lettering. This new procedure dispensed with much tedious, exacting and slow work. "Three young ladies", it was officially noted, "were added to the staff to do the stamping." By 1919 some maps of interprovincial boundaries had been drawn for "photozincographic printing"—an awesome technical term for those times.*

In the course of the half-century under review four principal map series of major scope and purpose featured the output of topographical map work by Canadian government agencies, including the Department of National Defence. In order of their appearance these were known as the Sectional Map Series, the Chief Geographer's Series, the Geographical Section, General Staff Series, and the National Topographic System. In 1891 the first sheet was issued of the Sectional Map Series on its scale of 3 miles to the inch. This was a map of the Edmonton area, subsequently identified under an initial numbering system as Map No. 79, later as Map No. 315. These sheets were printed by authority of the Department of the Interior and were based on office compilations of surveys under the Dominion land survey system. The earlier maps lacked contours but showed highways and homesteads. About 134 sheets in all were published in this series up to 1922, although some of these maps underwent revision more than 25 years after that. In 1905 it was provided, in theory, that this series would include all of Canada. In fact, however, this series never covered more than the three provinces of the western interior, British Columbia and a single map of Dawson, Yukon Territory.

The Sectional Map Series suffered from several disadvantages. First, it did not cover areas of uniform size; second, the arrangement failed to allow for coverage by a progressive system of numbering and, third, no provision was made for including other than the 3-mile-to-the-inch scale. About 1919 these sectional maps were improved by the addition of contours. In subsequent field operations a new technique, employing batteries of aneroid barometers, for obtaining elevations, was adopted. Before this series of Canadian maps was discontinued the 134 sheets covered a total area of 536,000 square miles.

Partly because the Sectional Map Series was limited largely to areas in Canada west of

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*This is likely a misuse of the term because by 1919 rotary offset presses and normal photographic procedures were in effect generally.

Winnipeg, a new map series was introduced in 1903. This became known as the Chief Geographer's Series. Contours were not shown but elevations at railway stations were indicated. Up to the middle of the 1930s 60 maps of this series had been issued on scales of 1:250,000 and 1:500,000. These scales were apparently chosen in order to fit in with the decimal system and yet keep close to the conventional English scales of 4 and 8 miles to the inch. The first sheet of the Chief Geographer's Series portrayed part of southwestern Ontario. No provision was made for expansion of this series on the basis of other scales, nor did the sheets join properly with the most easterly sheets of the Sectional Map Series.

Several attempts were made to bring Canadian topographical mapping under a single comprehensive system. An index system was initiated in 1912, based on the three-mile sectional sheets but this was never put into effect. In 1923 another abortive attempt was made to inaugurate a national topographic system, based on numbered primary blocks corresponding to the "Carte du Monde" or Millionth Map; numbered primary blocks being 4 degrees of latitude by 6 degrees of longitude.

In 1927 the present National Topographic System, which was designed to include Newfoundland if and when its government agreed to this participation, was instituted. This series of maps derived some of its attributes from the Survey of India System, mainly in respect to layout of sheets and the relationship of various scales used. Though provision was made for 1-mile, 2-mile, 4-mile and 16-mile-to-the-inch scales in this National Topographic System, there was a definite lack of any 8-mile-to-the-inch scale. The National Topographic System maps have continued to be issued and represent the latest stage of advancement reached in the production of accurate Canadian topographic maps of practical application.

After the First World War a decline in public demand for land surveys in the west enabled the Topographical Survey Branch to use the special training and knowledge of Dominion land surveyors on staff to work in the western interior on topographic surveying and mapping. Information previously gathered by surveyors in the prairie region of Canada had become out of date or was incomplete. Since original surveys had been made, some streams had altered their courses, certain lakes had dried up, swamps and marshes in many instances had drained, bush in various places had given way to cultivation, railways had been built and small settlements had grown into thriving towns and cities. With the aid of these post-war surveys, sectional maps were transformed into topographic maps of a high order of representation. In open country a field survey party could revise one sheet covering 4,300 square miles during a single season.

With sectional-sheet revision it became necessary to introduce township-outline levelling, consisting in each case of a line of levels coinciding with the boundaries of a township.[14] Every material undertaking by man for the advancement of the human lot involves the determination of levels whether it is a homesteader seeking to drain his land or a civil engineer designing the route of a new railway line. As soon as office records concerning levels within a country begin to accumulate it becomes necessary to refer or relate these findings to one common surface so that the difference in altitude between two points can be calculated. In a country such as Canada the ideal datum is one which can apply to various places, independently of any fluctuations in land surface. Mean sea level, the surface the ocean would assume at the coastline, if not acted upon by external forces, supplied the only reference surface that could meet this requirement. The determination of mean sea level can be made authoritatively from continuous tidal observations over a period of years.

A great stride forward in levelling aspects of surveying and mapping in this new nation was taken in 1901 when James White's book, *Altitudes in the Dominion of Canada*, was published at Ottawa as a report to the Geological Survey. The book constituted the first general compilation of altitudes undertaken in this country, a project that began as a private investigation. Incidentally this volume included a geological relief map of Canada and the United States, printed in brown tints, and bearing the name of C. O. Senécal, Chief Draughtsman of the Geological Survey of Canada. A second (revised) edition of the book was published by the Commission of Conservation, Ottawa, in 1915. White's supplementary work, *Dictionary of Altitudes in the Dominion of Canada*, first published when he was Chief Geographer, was followed by a second edition in 1916.

In the introductory notes in his first volume on altitudes White pointed out that with the exception of the work of R. Steckel of the federal Department of Public Works, very little had been done in Canada in the form of levelling up to the end of the 19th century. The first precise levels in this country were those run by Steckel in 1883. These originated at a United States Coast and Geodetic Survey bench mark at Rouses Point, near the International Boundary south of Montreal, and were carried along the Richelieu River to Sorel on the St. Lawrence River. The purpose was to establish accurate vertical control for harbor and river improvements. All the levels run by the Public Works Department were adjacent to waterways and mainly confined to eastern Canada along the St. Lawrence and the Great Lakes. The Department continued to run levels until 1931, at which time its system comprised in all about 5,600 miles of such levels and about 3,800 bench marks.

In 1884 J. W. Spencer, in a bulletin of the United States Geological survey included elevations on a number of railway lines in eastern Canada. Five years later W. Upham published tables of altitudes relating to the southern parts of the North-West Territories.[15] But these activities constituted all of the precise levelling work attempted in Canada up to the turn of the century and until White's volume appeared. In compiling his tables White used railway and canal profiles, elevations of railway stations and sidings, river crossings, depressions and summits, canoe routes, lakes and mountain passes.

In 1931 the Department of Public Works transferred to the Geodetic Survey of Canada all original field books and records based on its precise level operations, activities that had commenced nearly a half-century earlier. By 1934, when amalgamation and coordination of these functions within a single organization were completed, all precise levelling in Canada became consolidated into one national system, referred to one datum. This datum, mean sea level, was to be determined at coastal points by the Canadian Hydrographic Service and extended inland by the Geodetic Survey of Canada.[16]

Not all the mapping and map making in Canada between the time of Confederation and the First World War took place under federal government auspices. The governments of Ontario and British Columbia, for example, encouraged these important activities within their own boundaries.

Ontario

The mapping of what is now Ontario under instructions of provincial authorities had its origins prior to 1856. In that year Commissioner of Crown Lands of Canada, Hon. Joseph Cauchon, reported that a map of [the Province of] Canada was being prepared in his office on a scale of 2 miles to the inch, showing lots and ranges of townships. The Commissioner indicated that "several maps of the Province have been published but none on so large a scale as to meet the requirements of the Department". He paid tribute to the excellence of Joseph Bouchette's 1846 map but explained that it required a scale so small that subdivisions of townships could not be represented. As early as 1831 Bouchette's map of the Montreal district, Lower Canada, included a number of counties in Upper Canada (Eastern Ontario) along with an insert showing the route of the then newly-completed Rideau Canal, with elevations marked at points along its course. This map was published in London, England, by James Wyld.

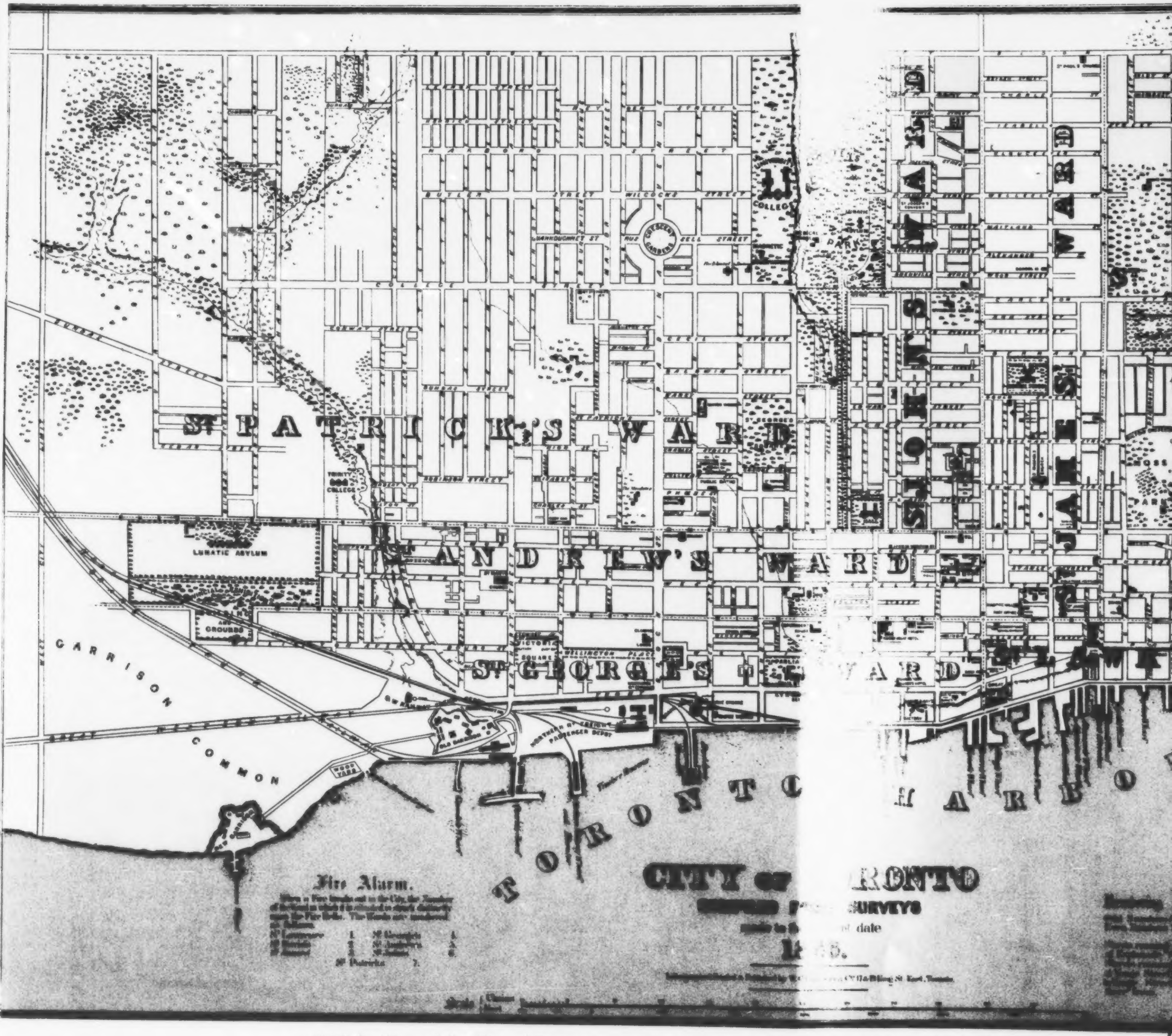
Cauchon observed also that as previous maps of the Province of Canada had become more or less obsolete and as parts of them were founded on imperfect information, he hoped the map that he had in the course of preparation would avoid such inadequacies "because nothing will be introduced into it that has not been determined by survey . . .". He promised as well the production of an edition of the map on a scale of 12 miles to the inch "for the more ordinary purposes for which a general map of the Province is required". Considerable doubt has continued to exist over whether these maps ever reached the publication stage. There is, however, in the Ontario Archives a map of the North West Part of Canada, Indian Territories and Hudson's Bay, compiled and drawn by Thomas Devine, Provincial Land Surveyor and Draughtsman, published in 1857 under the authority of Commissioner Cauchon. No scale is given and few settled parts of territory now included in Ontario are shown.

One of the earliest examples of systematic mapping and map making in Ontario was the Huron and Ottawa Territory Series. Editions of this map appeared almost every year from 1861 to 1867 inclusive and from time to time during the remaining years of the 19th century. The 1888 version was hand-colored. In the beginning maps of this series were published by the Crown Lands Department at Quebec, with the drafting work directed by Thomas Devine. On the 1868 edition the name of Rae Smith appears as engraver. The demand for this series likely arose from increasing settlement activity and from the relatively lucrative lumbering industry in that part of Canada. The 1861 and 1862 issues showed routes of colonization roads and were printed in New York City. Waterways were depicted by blue tints and roads by red lines. The 1863 edition, on a scale of 5 miles to the inch, portrayed land and soil categories by the use of solid blocks of red, grey and brown. All these maps were published by the Crown Lands Department of Upper Canada. The name of H. F. Hayward appears as draughtsman on many of these productions. Plans and maps were also being produced in this period under the same auspices and depicting the north shores of Lake Superior and Huron, published by W. C. Chewett and Company, Toronto. By 1866 yellow map tints were being employed to denote mining locations, red to identify Indian Reserves and blue to indicate the trend of shorelines.

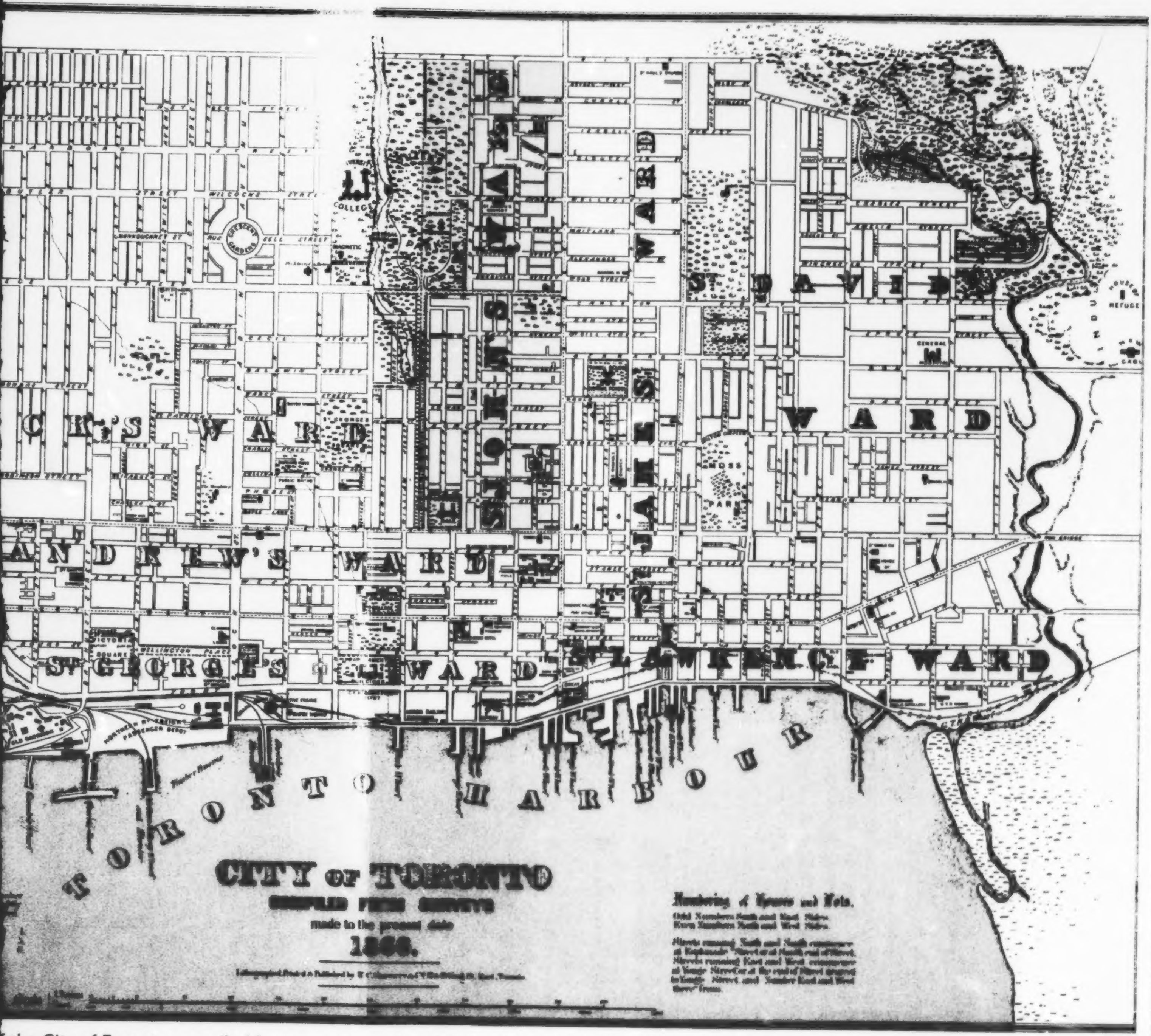
In 1872 Commissioner R. W. Scott reported that he had ordered the preparation of maps showing townships "recently surveyed", also colonization roads. Maps of mineral claims "patented at Thunder and Black Bays" as well as maps of Lakes Superior and Huron were issued on the scale of a mile to the inch. These were published by Copp, Clark and Company of Toronto, a firm that was destined to become prominent in Canadian map lithographing work. This 1872 mention may well represent the first time this firm's name appeared on any government-authorized map concerning lands within the new province.

In 1893, with the creation of Algonquin Park as a provincial preserve a new series of Ontario government maps came into being, the Algonquin Park Series. The 1893 map of the park was printed directly from lithographic stones by a Toronto firm and was included in the report of the Ontario Park Commission. This map was revised and reissued in 1908, 1911, 1914 and 1921 and subsequently, in an effort to keep pace with park expansion and developments.

Despite these energetic attempts there remained a shortage of reliable official maps in relation to rapidly expanding requirements. In 1894 the President of the Royal Society of Canada declared that ". . . the actual state of the geographical delineation of the older provinces leaves much to be desired. Many parts of these were surveyed during the early history of the country by methods which would now be regarded as extremely primitive, while no such thing as a topographic map exists for any considerable tract in any of these provinces; although some approximations to such maps have been attempted in certain districts by the Geological Survey, for its own purposes. . . ".[17]

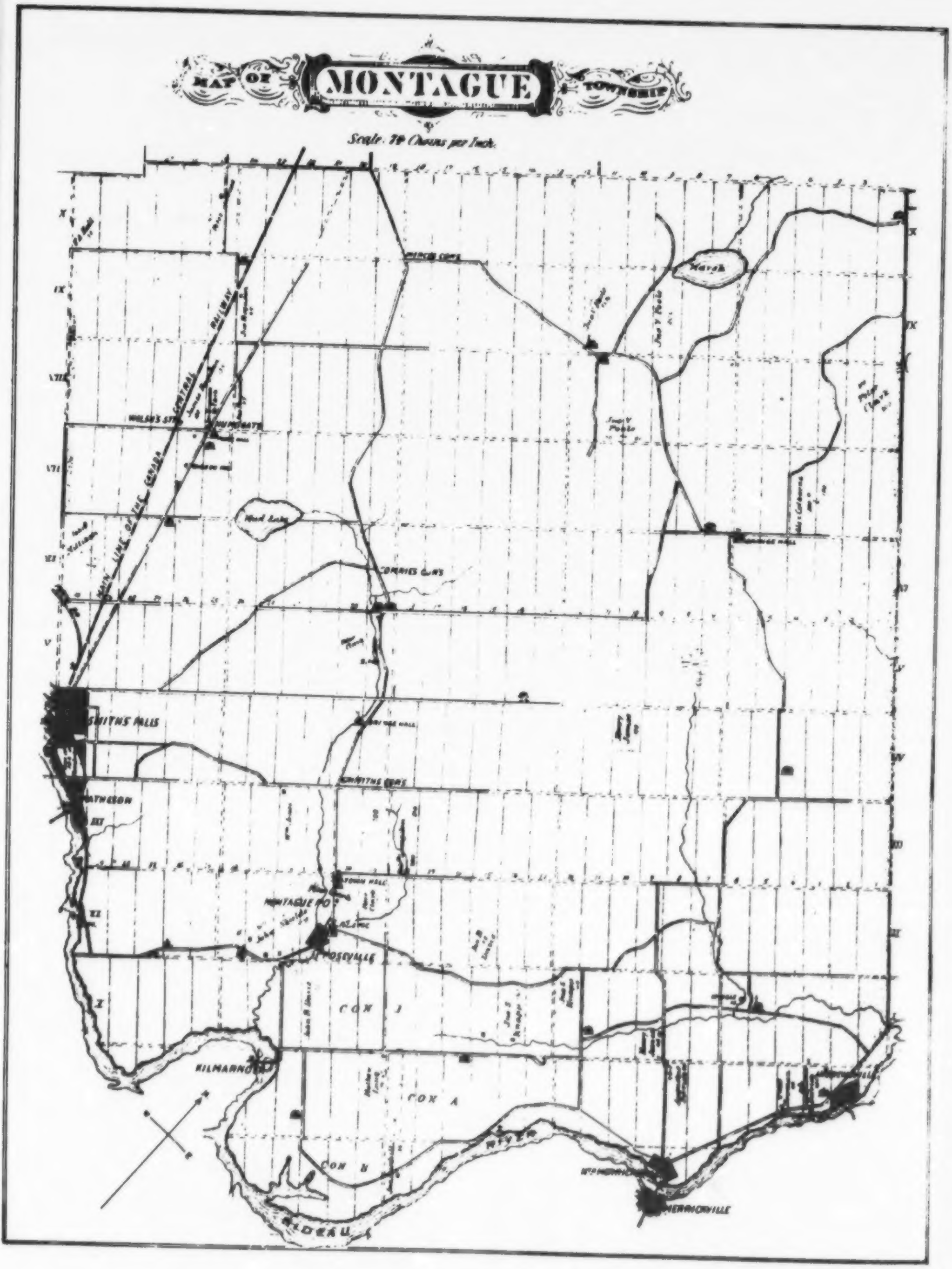

ST PATRICK'S WARD
ST ANDREW'S WARD
ST GEORGE'S WARD
ST JOHN'S WARD
ST JAMES WARD
GARRISON COMMON
TORONTO HARBOUR
LUNATIC ASYLUM
TRINITY COLLEGE
CRESCENT GARDENS
WILLINGTON PLACE
VICTORIA SQUARE
OLD GARRISON
WOOD YARD
Fire Alarm.
CITY OF TORONTO
SURVEYS
date

MAP 9. Plan of the City of Toronto, compiled from surveys made to 1866, published by W.C. Chewett and

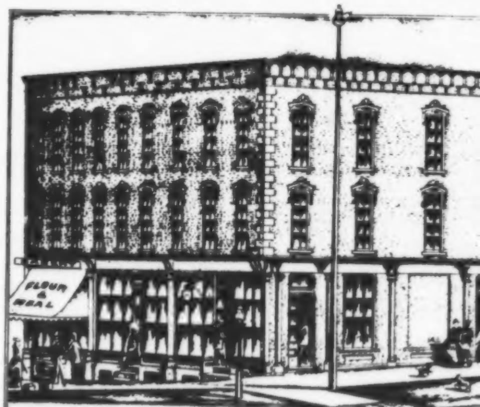


CITY OF TORONTO
COMPILED FROM SURVEYS
made to the present date
1866.
TORONTO HARBOUR
ST. DAVID'S WARD
ST. JAMES' WARD
ST. LAWRENCE WARD
ST. ANDREW'S WARD
ST. GEORGE'S WARD
ST. JOHN'S WARD
COLLEGE
MOSS PARK
GENERAL HOSPITAL
REFUGE
Numbering of Houses and Lots.

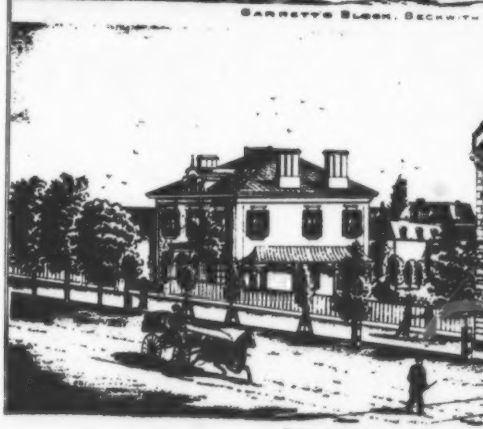
the City of Toronto, compiled from surveys made to 1866, published by W.C. Chewett and Company.


MAP OF MONTAGUE TOWNSHIP
Scale. 70 Chains per Inch.
MAIN LINE OF THE CANADA CENTRAL RAILWAY
WILSON'S STA.
Marsh
Mud Lake
COMRIES CORS
SMITHS FALLS
SMITHS CORS
MATHESON
TOWN HALL
MONTAGUE P.O.
ROSEVILLE
CON I
CON A
CON B
KILMARNOCK
MERRICKVILLE
RIDEAU RIVER

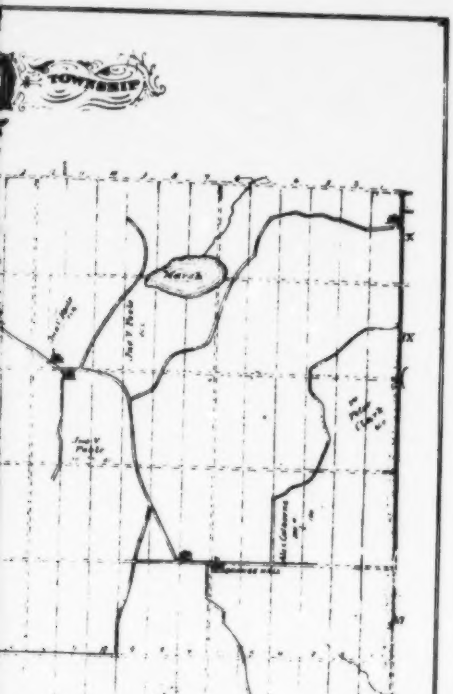
MAP 10. Map of Montague township, Lanark county, Onta
published by H. Belden and



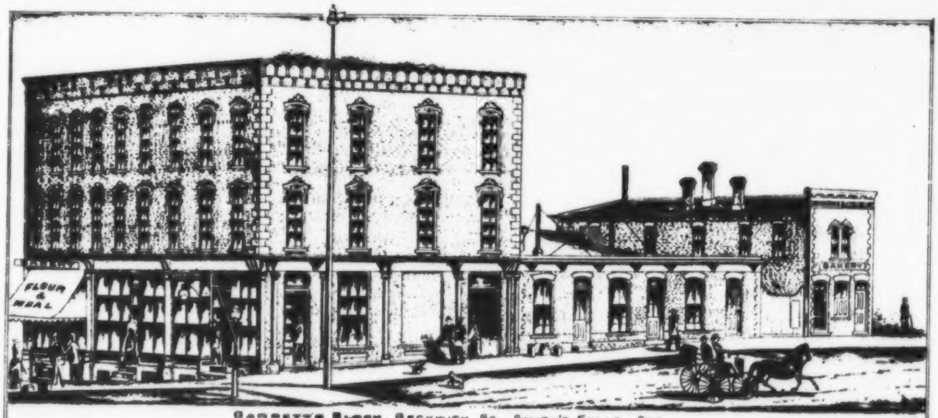
GARRETT'S BLOCK, BECKWITH



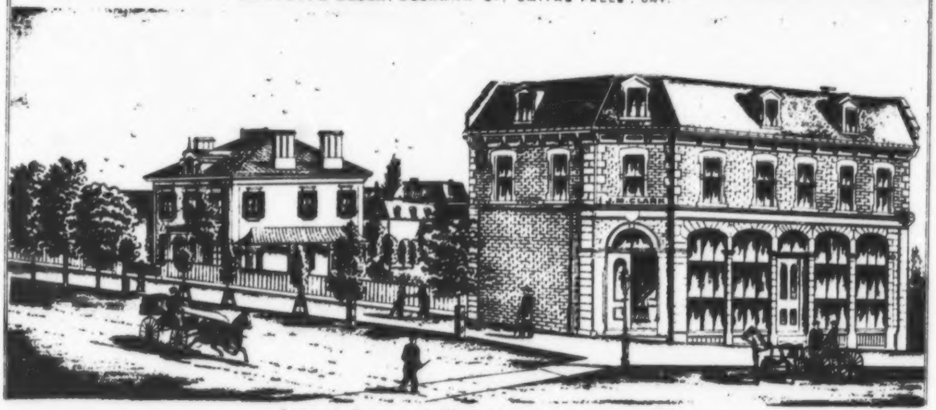
STORE & RES OF J. M. C


TOWNSHIP
MERRICKVILLE

MAP 10. Map of Montague township, Lanark county, Ontario, illustrated with local sketches from *The Atlas of Canada* published by H. Belden and Company, Toronto, 1880.


FLOUR & MEAL
BAKERY

GARRETT'S BLOCK, BECKWITH ST. SMITH'S FALLS, ONT.



STORE & RES. OF J. M. CLARK SMITH'S FALLS, ONT.

The Lake of the Woods Series of Ontario government maps began in 1897. In 1903 and subsequent years revisions were made and reissues published. A Rainy Lake Series followed. In 1899 a map of the province, ostensibly the work of Copp, Clark and Company was published and, curiously, bore the official Ontario crest. Undoubtedly the map was the work of draughtsmen in the employ of the provincial government.

In 1900 Commissioner of Crown Lands E. J. Davis reported in connection with Ontario territory lying between the Canadian Pacific Railway and James Bay that "the reports of the various exploration parties, together with a map of the country explored, will be printed and presented to the Legislature concurrently with this report." In 1903 the Crown Lands Department issued a revised map of part of Kenora District on the scale of a mile to the inch. This map underwent subsequent revisions. In 1910 as a result of survey work by Louis Valentine Rorke (who became Ontario Director of Surveys in 1918 and later, Surveyor General of the province) a "Plan of the Townsite of Winnipeg River Crossing on the National Transcontinental Railway, District of Kenora", was published by E. H. Harcourt, Toronto, on the scale of 200 feet to the inch.

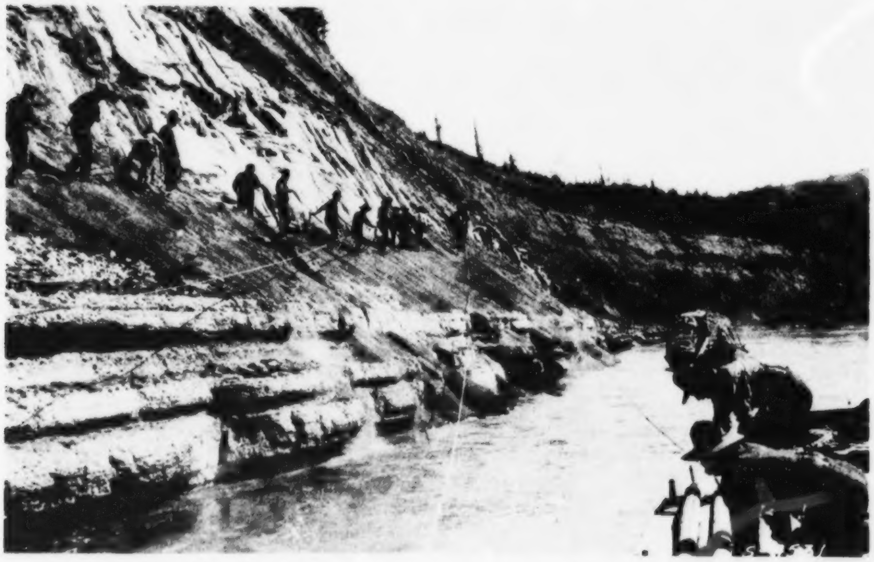


FIGURE 54. 'Lining' survey barges upstream in swift water, 1900.

From 1901 to 1904, when the final report of the Commissioner of Crown Lands for Ontario was issued, no mention was made of maps constructed or published. Nor were any references of this nature contained in succeeding reports of the Minister of Lands and Mines or of his successor, the Minister of Lands, Forests and Mines to the end of the period under review.

In April, 1912, a significant and timely report was made to the Ontario government by W. R. Rogers, who had spent several days in Ottawa in the previous month, apparently on the instructions of provincial authorities, investigating equipment and methods being employed in the several map-making bureaus of the federal government. Rogers advised that the topographic contoured maps being produced by the Geological Survey of Canada were of a high order of excellence, equal to those of the United States Geological Survey but that the cost of this work was high. He pointed out that Chief Geographer J. E. Chalifour of the Department of the Interior, Ottawa, had offered to supply Ontario with transfers from copper plates whenever provincial authorities might need them for map compilation. Rogers also commented that compared to the standard topographic sheets then being issued by the Interior Department on scales of 4 and 8 miles to the inch, maps published by the Ontario Surveys Branch were inferior. He suggested that if a new map of Ontario was to be undertaken by the province, federal maps should be used as a basis for the project. He called attention to the fact that the province of Quebec was making rapid strides in improving methods of map preparation and reproduction and that "unless we spend more money on map work we'll soon be outstripped by that province."[18]

In a memorandum to the Deputy Minister of Lands and Forests, dated May 21, 1921, Director of Surveys Rorke listed 24 maps depicting various areas of the province and published under the direction of the department. He cited the costs of production in each case. "While the costs of printing some ten to twenty years ago did not amount to a large sum in the year", the Director observed, "it will be noted that [these] have so increased . . . that the Department would be justified in making a charge for maps supplied . . . ".

During most of the 50-year period under review a highly useful contribution to Canadian mapping was also made by the Ontario Bureau of Mines. Geologists in the employ of the province began mapping in 1881. Ten years later the Bureau of Mines was created to form part of the Crown Lands Department. In 1920 this organization became the Ontario Department of Mines, after its separation from the Department of Lands, Forests and Mines. Up until 1917 the Bureau had issued 88 maps, many of which are now out of print. Although the primary purpose of the sheets was to convey geological information, these were also detailed planimetric maps. The earliest maps of this nature were area compilations at various scales from 2 miles and 8 miles to the inch.

The Cobalt silver camp, the first major ore discovery in the province in the 20th century, was mapped in detail by Mines Bureau personnel using cadastral survey control supplemented by plane-table work, underground surveys and mining plans. For the more general areas, gaps between base or meridian lines were mostly filled in by surveys along mining claim lines. By 1917 most of the then known mineralized areas had been covered by at least some mapping. All such maps were accompanied by highly detailed and well-illustrated printed reports with references to means of access, topography, wild life and vegetation.

British Columbia

In British Columbia pressures for increased map production mounted with a marked growth in population in that province after 1871 and with the quickening pace of resources development. An expanding mining industry was mainly responsible for the steady demand for more detailed cartography although lumbering, fishing and farming contributed to the growing need.

Cadastral surveys on which any mapping had to be based were largely scattered and unrelated in earlier post-Confederation years but gradually some of the separated patterns were joined. The all-too-frequent failure of boundary lines to coincide on such contacts proved the need for a system of over-all control. Probably the first sustained effort to establish primary triangulation for this purpose was made by Tom Kains (1851-1901), who occupied the post of Surveyor General of British Columbia from 1891 to 1896. In his 1892

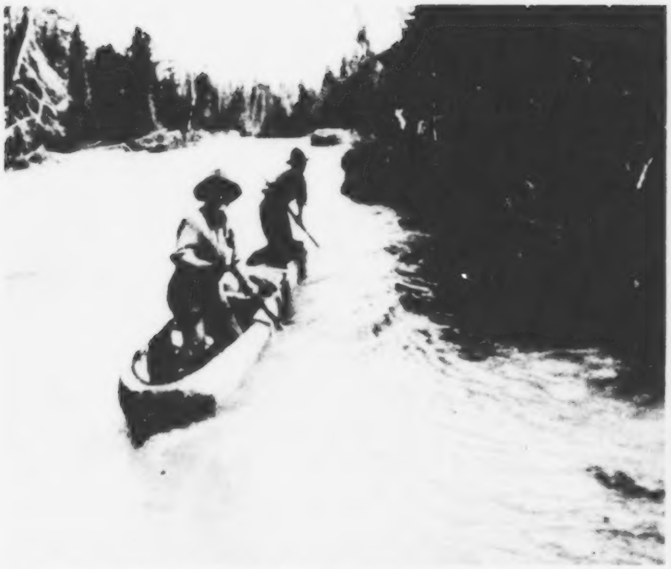


FIGURE 55
Surveyor-mappers in a cottonwood canoe of their own construction on the Naniko River, B.C.

annual report to the Chief Commissioner of Lands and Works, Kains stressed the importance of topographic mapping in the province and drew attention to the technique of phototopographic surveying in mountainous regions, as introduced six years previously by Deville. Kains suggested that panoramic photographs be taken from each camera station occupied in connection with a system of triangulation surveys proposed for British Columbia and from which contoured maps could be compiled.

In subsequent years up to 1900 a fair beginning was made on the Kains' program. Ontario-born W. S. Drewry (1859-1939), who proved to be an apt pupil of the Ottawa triumvirate of Deville, Klotz and King, came to the coast province in the early 1890s and in 1892 commenced a map of the Nelson area, which published in 1896 was the first contoured map of any part of British Columbia on which colors were used to portray various types of topographic information.

In that period there was lively activity in the staking of mineral claims in the Kootenays and in order to tie in these scattered holdings, local triangulation nets were established called Mineral Monuments or, more briefly, "M.M.s". Prominent in the performance of these surveys, commenced in 1896 were Ernest Albert Cleveland (1874-1952), and James Herrick McGregor (1869-1915).[19] Cleveland's work resulted in 1898 in a map of part of the East Kootenay. Based on the field work of this competent Dominion and provincial land surveyor this sheet appears to have been the first printed map of a British Columbia area serving to emphasize the importance of triangulation control.

The remarkable exploratory and mapping accomplishments of a pioneer missionary, Rev. Adrian Morice, deserve mention also. Equipped with only a compass, barometer and sounding line and making use of the topographic ability of Indians of the region Father Morice mapped an area some 200 miles wide centred on his Fort St. James base on Stuart Lake between the years 1883 and 1904. His sketches and field notes were compiled into the first detailed map of the region including numerous lakes, soundings and drainage features as well as mountain peaks with elevations, trails and settlements. The two-color map was published by the Chief Commissioner of Lands and Works, Victoria, in 1907, on a scale of 10 miles to the inch under the title: *Map of the Northern Interior of British Columbia, by A. G. Morice, O.M.I.*

In the last decade of the 19th century many regional maps were issued in succession to district maps made by the Royal Engineers thirty years previously. This impetus in map production can also be laid to Kains' policies of 1891-92. Prior to this date cadastral surveys were the main activity and lithographed maps were few and of a general nature. One highlight of this period, however, was the production in 1886, under joint federal-provincial auspices, of a map of the Cariboo district by Amos Bowman, assisted by James McEvoy. This product may be regarded as the first large-scale accurate map to be published of any part of the land mass of British Columbia.

Some 50 maps were published under Kains' direction, mostly in the southern explored areas of the province; however, the Klondike Gold Rush in 1897, focused attention on northern British Columbia, which resulted in a succession of maps of the Atlin Gold Fields.

The great activity in land settlement and timber lands occurring in 1906-07 resulted in 1908 in the formation of a Department of Lands, separated from the Lands and Works Department which had been responsible for surveys until then. A re-organized Surveys Branch, recognizing the need for a framework of base maps, developed a reference map system of quadrangle sheets on one or two miles to one inch, on which to plot the daily land transactions. From their inception, these also provided the compilation bases for most of the lithographed series until a compiling section was formed following the First World War. Mr. Joshua E. Umbach (1879-1930) (later Surveyor General 1917-30) contributed to this program as Chief Draughtsman from 1911 to 1917, followed by F. O. Morris in 1917.

Early in 1912, George G. Aitken, a draughtsman with the Geological Survey of Canada was approached to organize, as Chief Geographer of British Columbia, a geographical division of the Surveys Branch empowered to prepare and publish maps of the province for the government at Victoria. On the mapping side, as distinct from map making, the Topographic Section (later Division) was born in the same year as part of the same Branch.

Impressed by the opportunity offered him in the coast province Aitken resigned from the Geological Survey of Canada in May, 1912, and proceeded to Victoria where he met, in turn, the British Columbia Surveyor General from 1911-17 George Herbert Dawson (1866-1940) and the premier of the province, Sir Richard McBride. Sir Richard explained that his efforts to obtain a suitable map of the southerly part of British Columbia had been disappointing. In his view there was an imperative need for a large wall map to form the first unit of a provincial series. Aitken, with some trepidation, respectfully inquired if the premier had in mind a definite span of time during which the work of compiling, drafting and printing such a map should be completed. "Yes," replied Sir Richard, "six months."[20] This limitation, in view of the scope of the project, presented a formidable challenge to the new Chief Geographer. The embryo Geographic Section or Sub-Branch was formed with commendable celerity. Two experienced map draughtsmen, W. H. Firth and Hugh C. Smith, left the federal civil service to join Aitken's staff. H. M. Wright was recruited from the provincial Surveys Branch and several other minor aides were obtained locally. First printed copies of what had developed into a 4-sheet wall map were in circulation within eight months of the premier's request for action. This map, drawn on a scale of 1:1,000,000 (15.78 miles to the inch) proved sufficiently satisfactory to continue in use for 21 years.

The first mapping from ground photographs for the provincial government occurred in 1913 when R. D. McCaw (1884-1941) made a topographic survey for the Public Works Department along part of the Banff-Windermere highway, then under construction. In 1914, McCaw began work for the Surveys Branch of the Department of Lands, mapping an area in the Okanagan region. For several seasons following 1914 McCaw was the sole provincial practitioner of the photo-topographical method.[21]

The re-organization of 1908, also saw the establishment of a survey control policy of cutting out internal base lines on meridians and parallels. The First World War drew this program to a close and also placed a temporary halt to the reconnaissance topographical mapping in northern British Columbia that was started by F. C. Swannell in 1908 and extended to the northern boundary of the province by E. B. Hart and G. B. Milligan in 1913-14.

FIGURE 56
A. J. Campbell

Gradually a comprehensive control system was developed in the territory between the 49th parallel and the Alaska Panhandle as well as in the Rocky Mountains along the British Columbia-Alberta border where surveys employing photo-topographic methods were carried out under the direction of A. O. Wheeler, aided by A. J. Campbell. Outside the Railway Belt and the Peace River district provincial authorities were responsible for cadastral surveys. Land lots and mineral claims were surveyed by transit and chain, timber limits by the use of compass and chain.[22]

In the period immediately preceding the First World War the increasingly heavy demand for maps of various parts of the province was met on an improvised basis. Outdated maps were republished by the province from time to time, corrected whenever possible. The land boom had reached such proportions by 1913, that a catalogue in that year listed 38 provincially produced maps published or in course of production in the period from 1911, including 8 sheets of the Pre-emptor's Series. One of these, depicting Bulkley Valley, is a fair example of the cartographic work being done under provincial government direction at that time. The map showed land lots available for settlement and included the Telegraph Trail.

As a continuing program, British Columbia's provincial topographic mapping activities may be said to have commenced with the McCaw field party of the 1914 season. The crew operated as a single unit until 1920 when it was expanded into two field parties. By 1914, a multiple-point plan of systematic map production was laid down and proved reasonably durable. The Pre-emptor's Map Series, on a scale of 3 miles to the inch, was designed to meet the needs of land-seekers. Cadastral surveys were depicted and the status of lands (whether or not alienated from the Crown) indicated by map colors. Some sheets bore explanatory notes on agriculture, mining and forestry. The 1897 map of part of the Osoyoos district, issued by the Office of Lands and Works, was a forerunner of this series. Another group of maps, the Degree Map Series, produced on a scale of 2 miles to the inch, covered the earlier settled areas of the province north of the 49th parallel and adjacent to it.

In retrospect it would be fair to concede that good progress had been made in the fifty years following Confederation in the mapping of Canada by Canadians. But it was becoming increasingly clear to cartographers and surveyors that the task of mapping a nation so vast must be a continuing enterprise, a process that could never quite reach the elusive goal of perfection. The term 'finished map' could be used only in a relative sense, no matter how diligent or talented the efforts made to keep maps accurate and up to date. As long as economic expansion persisted and new sources of natural wealth were being brought to light, it would be necessary to add to information recorded in cartographic form for the enlightenment, use and reference of all.

During the period from Confederation to the First World War it was becoming more widely realized that in times of peace or of war, maps constituted much more than attractive sheets of colored paper. Portrayals designed to inform, guide and illuminate maps had, in fact, become indispensable to the full status and orderly growth of the nation. A good map could be accurate without being unctuous, graphic yet reliable and capable of speaking a universal language. Because, in essence, a map is more picture than text it had the power to attract immediate, curious attention and to encourage swift comprehension.

"A map in the hands of a pilot", declares an anonymous tribute to the cartographic art, "is a testimony of a man's faith in other men. It is a symbol of confidence and trust . . . Were all the maps in the world destroyed . . . each man would be blind again, each city would be a stranger to the next, each landmark becomes a meaningless sign-post pointing to nothing. . . . Here is your map, unfold it, follow it . . . it is only paper and ink. But if you think a little . . . you will see that these things have seldom joined to make a document so modest and yet so full of histories of hope or sagas of conquest."[23]

8

DEVILLE AND THE SURVEY CAMERA IN CANADA

Following completion of the Canadian Pacific Railway through the Rocky Mountains in 1885 it became imperative that surveying and mapping of British Columbia, particularly of the Railway Belt in that province, be completed as soon as possible. Maps were urgently needed for the establishment of points of departure for the opening up of mining claims, timber limits and farmlands to occupation and development.

During the decade and a half that followed the creation of Manitoba as a province in 1871 the survey of Canada's western interior had been relatively rapid and accurate. But suddenly a brand new situation faced topographers. From the Alberta foothills to Pacific tidewater they were confronted by a land consisting mainly of hills, craggy peaks and deep valleys. When Dominion land surveyors reached the high Rockies they realized that survey methods used so successfully on the prairies were only partly applicable to mountainous regions. In the generally level interior outstanding topographical features were few in number. In the Rocky Mountains conditions were reversed. Topographical features were both numerous and prominent. To lay out township and section lines would take considerable time and costs of operations in the field would be high unless some new method was adopted.

Other factors demanding rapidity in mountain surveying included vagaries of weather in such regions and the rugged nature of the terrain. In a climate where the open season for field surveys is limited, as a rule, to little more than three months, the ability of surveyors to cover any large tract of country in a short time became a matter of urgent importance. The very act of reaching a survey site, commonly located on a lofty summit, was in itself a time-consuming enterprise. In addition the frequency of sudden, severe squalls and of strong winds meant that at best only a few hours of stable weather could be counted upon for observation purposes. In the limited time available for field work it was physically impossible to record by notes or by memory the immense variety of topographic detail to be found in mountain country.

Dr. Edouard G. D. Deville, Surveyor General of Canada, in his wisdom, concluded that in order to survey such terrain speedily, effectively and at moderate cost, it would be necessary to employ photography in an auxiliary role. Not that the application of the camera to surveying was something new. In some respects the employment of photography in this field was as old as the art itself. But Canada, particularly during the closing years of the 19th century, used the survey camera over areas unexceeded in extent by any country in the world.[1] In the truest sense Deville may be said to be the father of photo-topographical surveying in Canada. He set about designing instruments that would be particularly suitable to Canadian requirements. These had to be adapted to transportation over long distances and difficult terrain and yet be capable of calibration in the field. With only a few minor improvements Deville's system continued to give good results in the first half of the 20th century.

FIGURE 57. E. G. D. Deville, Surveyor General of Canada, 1885-1924.

Towards the end of the 18th century a demand grew steadily in the civilized world for "pictures" of persons and of objects. Wood engraving revived and the art of lithography developed. Experiments were made in the use of the silhouette technique. L. J. M. Daguerre (1789-1851), a French painter who experimented with silver salts in order to discover their properties, by accident revealed the image or likeness produced by exposing an iodized silver plate in a camera, if the plate was first fumed with mercury vapor.

D. F. J. Arago (1786-1853), a French physicist interested in the investigation of basic laws of polarization of light, reported fully on Daguerre's invention to a meeting of the French Academy of Sciences on August 19, 1839. The process, named "daguerreotype" after its discoverer, proved highly successful, especially in the realm of portraiture.

W. H. Fox-Talbot, an Englishman, used other chemical agents in a process named "calotype". The image was developed on calotype paper and, in terms of light and shadow, presented an exact reverse of the object reproduced. Nevertheless this process was a genuine first stage in the progress of photography. But Daguerre's discovery provided a timely stimulant to the evolution of photography generally. All this took place before the midway mark in the 19th century had been reached.

The principles involved in the linking of picture-making to land surveying were first suggested by J. H. Lambert of Zurich in 1789. No substantial effort was made, however, to apply his theories in practice until 1791 when Beautemps Beaupré made an attempt to use a series of freehand sketches of sections of the Tasmanian coast and of Santa Cruz Island.

Beaupré, because these drawings lacked sufficient accuracy, failed to convince others of the feasibility of this method.

Although Arago, in publicizing Daguerre's experiments, indicated the relationship of his discovery to surveying, it was not until almost a quarter-century later that one Col. A. Laussedat (1819-1907) of the French Army, gave a full exposition of the method in his *Mémorial de l'Officier du Génie*. In this work he demonstrated the impressive amount of information that could be extracted from a photograph as well as the numerous processes available to a surveyor. Laussedat, in truth, may well be regarded as the author of photographic surveying. His studies extended over a period of many years and in 1859 he announced the successful culmination of his research to the Academy of Sciences in Paris. When that institution reported favorably on his method, surveying passed from the purely experimental stage to an accepted science.

Laussedat used a *camera lucida*, consisting of a four-sided prism mounted over a drawing board which, by a double reflection of rays through an angle of 90 degrees enabled the operator to see the image as though it was coming from the board and to make a freehand sketch of it. After many experiments and after a suitable lens became available, Laussedat substituted photographs for drawings in the process.

Deville, despite the fact that he had only just arrived in the office of Surveyor General of Canada, was quick to realize the special value of Laussedat's discoveries in the surveying and mapping of the extensive mountain regions of the Canadian West. He set about designing instruments that would be particularly suitable for Canadian requirements. These were so constructed as to be acceptable for transportation over long distances and across difficult terrain and yet be capable of calibration in the field. Deville's type of camera was adapted for photography in a horizontal direction only, and this continued to be satisfactory for practically all groundwork in the Rockies. With a few minor improvements Deville's system continued to give good results during the first half of the 20th century.

In the immediate aftermath of Laussedat's experiments the art of photography had taken important strides forward. In the early years of the American Civil War, Brady, the photographer, built up a world reputation for himself by his excellent camera work. The famous photograph of Lincoln and his generals at Antietam is a splendid example of his artistry. In Canada William Notman, as early as 1865, was producing such fine work as the excellent representation of the Parliament Buildings in Ottawa. More and more photography was becoming linked with the plane-table technique in surveying. Notable advances were made in the late 1870s in Italy under the leadership of Major-General A. Ferrero, Director of the Military Geographical Institute of that country. Photography was used in plotting sheets in mountain regions of a new map of Italy. Staff-Lieut. M. Michele, in 1876, plotted the Glacier du Bart following experiments with a plane-table and ordinary photographic apparatus. Also in Italy, Professor Porro, acquainted with Laussedat and his work, proposed for surveying purposes a camera built to receive spherical plates.

In 1889, in Ottawa, Deville published *Photographic Surveying*, a book in which he outlined problems of descriptive geometry involved in photo-topography. He dealt also with perspective and its application to the making of maps or plans from photographs. Also he described the instruments used in such work and the method of carrying on subsidiary triangulation necessary for delineation of geographical positions and the elevation of points from which photographs must be taken.

This 1889 edition was prepared for the sole use of Dominion land surveyors and was limited to 50 copies lithographed in the surveys office in Ottawa. Some copies found their way outside the service of the Department of the Interior, and the edition was quickly exhausted. A new edition of the work appeared in 1895, published by the Government Printing

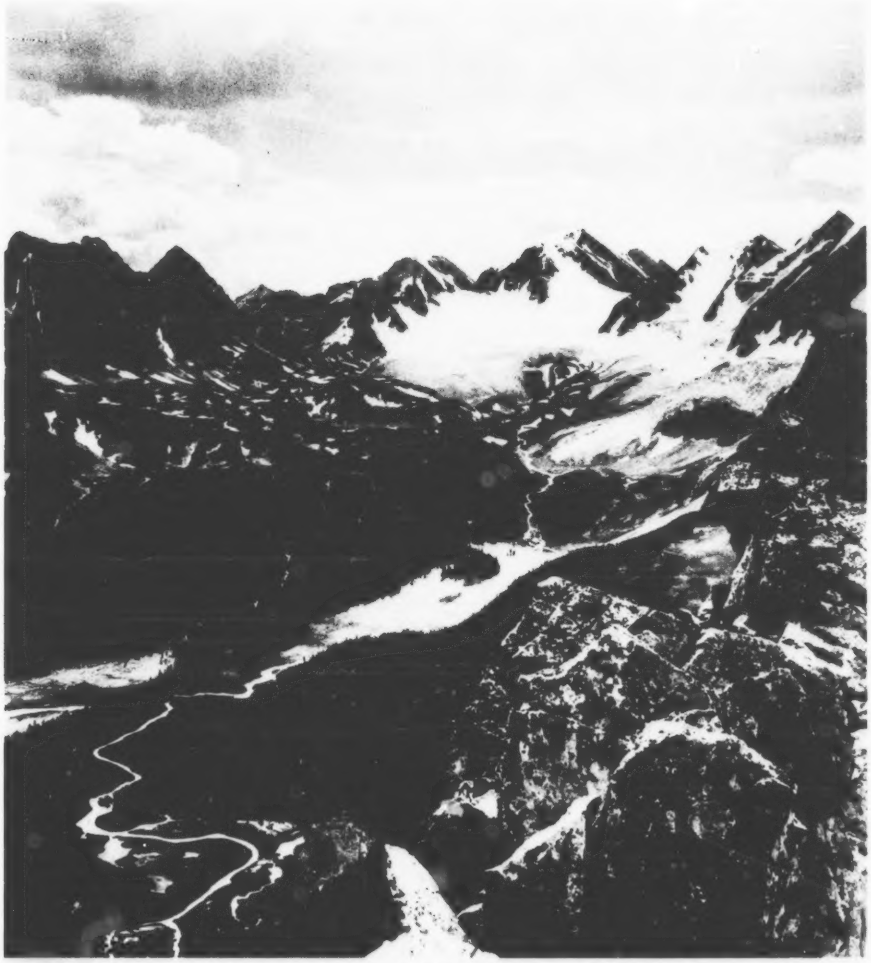


FIGURE 58. Jasper National Park view by M. P. Bridgland, showing type of mountain country requiring survey by camera method.

Bureau, Ottawa. In its *Preface* Deville pointed out that the photographic method of surveying was known at that time by several names, including photogrammetry and photo-topography. Such must be one of the very earliest official references in Canadian survey literature to photogrammetry, a science destined to play a highly significant part in 20th century surveying and mapping.

It was not, however, until George Eastman (1854-1932) invented what he called the "Kodak" camera in 1888 that interest in photography spread among members of the public. This was the first compact, portable camera and was the pioneer forerunner of the fixed-focus, fixed-exposure, roll film camera of the "box" type, appearing in 1900.

In 1886 J. J. McArthur, with a small party, set out to perform a topographical survey of the Rocky Mountains area along the Canadian Pacific Railway main line. He continued in this type of work for seven successive seasons. In that period he was able to map approximately 2,000 square miles using the scale of 1:20,000 and contour intervals of 100 feet. Along with a Troughton and Simms transit, with 3-inch circles reading to minutes and held on a tripod with extension legs (3 feet 4 inches when open: 20 inches when closed) McArthur was supplied with a camera which consisted of an oblong metal box open at one end and fitted into an inner case of mahogany. Inside the box were two sets of diaphragms to intercept any light not contributing directly to the image-forming operation. The whole interior of the box was blackened and a shade placed over the lens when the plate was exposed. The size of the plate was 4¾ inches by 6½ inches. A carrying case of leather held the camera and 12 single-plate holders and was fitted with shoulder straps. The total weight of the transit was 15 pounds and of the camera and plates, 20 pounds.

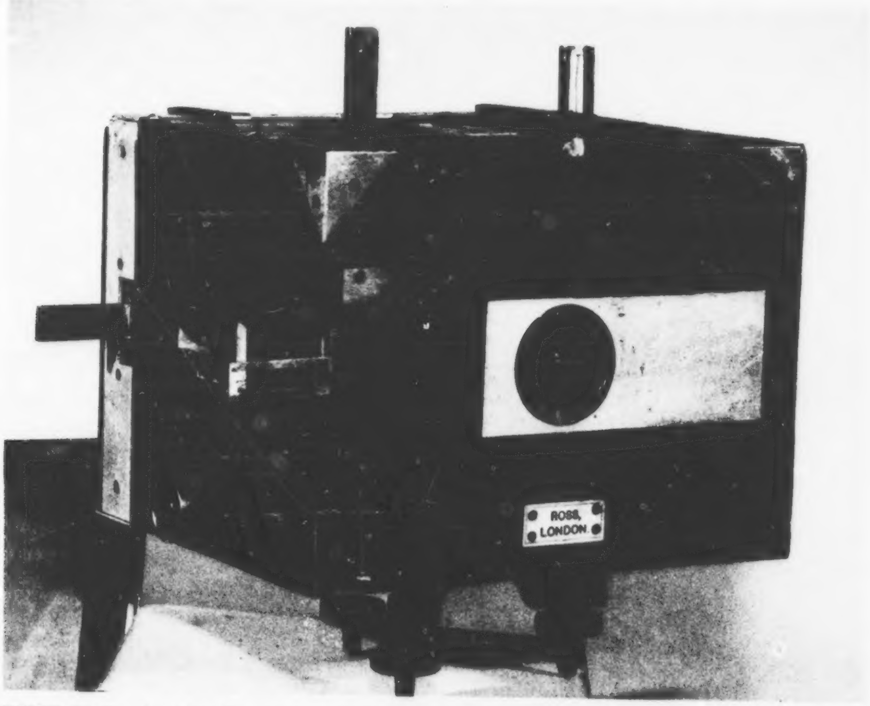


FIGURE 59. The shutterless Ross camera, made in England and equipped with hinged sighting bars, was one of the earliest makes used in Canada on surveys of mountain areas.

McArthur, in his official reports to the department, was most economical in references to photography as part of his survey activities. He never did contribute any substantial item to the literature of photo-topography. In 1886 he made no reference whatever to his possession of a camera in the field. In the following season he referred in his reports to Ottawa to a "convenient camera furnished us" and to "camera stations" as well as to "the taking of views" as part of his field work. But these are brief, almost casual remarks made in the course of a lengthy report.[2]

In the records, reports and articles written by various surveyors concerning the initial use of the survey camera in Canada there is an apparent conflict of opinion as to the exact year in which the practice was introduced to this country. J. S. Dennis Jr., in his short history of Dominion lands surveys from 1869 to 1889, stated under the heading "Season of 1886" that "an attempt was made during *this year* to introduce photography on the surveys, a number of surveyors being supplied with cameras. It was proposed to illustrate surveyors' reports by reproducing their photographic views, and it was desired to test the usefulness of photographs in providing topographical information."[3]

In an article published in 1897 Deville stated that the initial employment of the camera in Rocky Mountain surveys was in 1887.[4] In the preface of the (limited) edition of *Photographic Surveying* Deville again mentions 1887 in this regard. But in the preface to the later (1895) edition he omits reference to any specific year when dealing with the beginnings

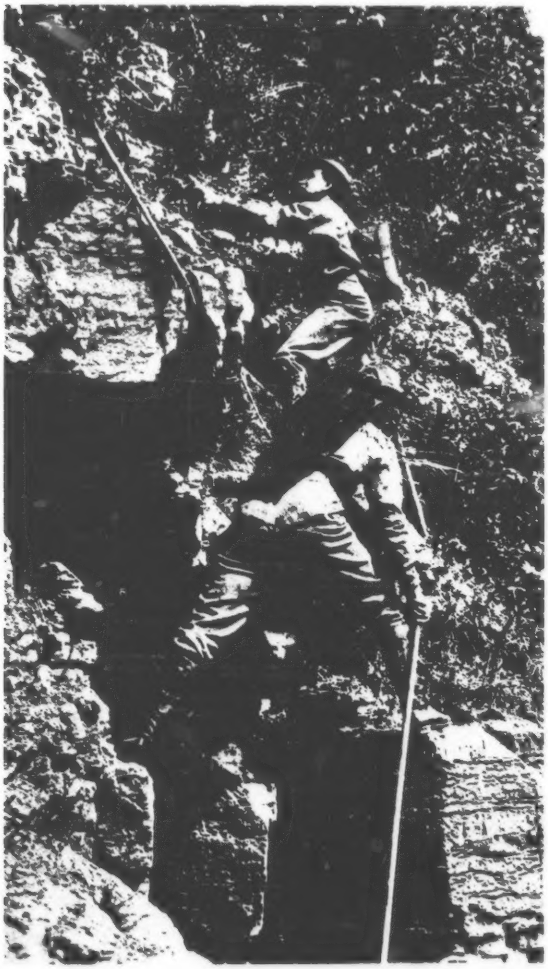


FIGURE 60
Topographer and assistant with survey cameras, climbing to an observing station. 1887.

of Canadian topo-photography. Bridgland and other writers on this subject give the commencement year as 1886. In Deville's report to his supervisors covering that year's work he inserted a paragraph that affords a possible clue to this curious discrepancy in dates. "An attempt was made", the Surveyor General stated, "to introduce photography on the surveys, a limited number of surveyors being provided with cameras. Photography has for a long time been used in the survey departments of most countries, and the processes have been so much improved of late that they now involve very little extra labor. Photography permits the obtaining of topographical information more easily . . . and economically than any other method; it is particularly convenient in a mountainous country, and is now often employed for work of that description. It was proposed to illustrate surveyors' reports by reproducing their photographic views, thus adding interest to their descriptions. Unfortunately the results have not, so far, been very satisfactory. It is hoped that, with some modifications in the apparatus employed and the experience of the previous years better work will be done next summer."[5]

In these remarks the emphasis is placed on the production of photographs for illustrative purposes rather than on the practical application of the camera as a survey or mapping aid. It is possible, also, that Deville did not consider accomplishments in photo-topography in the 1886 field season significant enough to justify selection of that year as the genesis of the practice in Canada.

In his 1887 report Burgess, in his capacity as deputy minister, Department of the Interior, stated that the "topographical survey of the Rocky Mountains along the line of the Canadian Pacific Railway is making satisfactory progress and although the proportion of the survey staff engaged in this work is smaller than in the previous year, the Department has been able to profit by the experience of the past. . . . It is important to observe", he added, "as is stated by the Surveyor General, that with the assistance of a small camera, the surveyor is able to obtain and plot upon his maps details of the topography of the country which, if the methods hitherto pursued had been adopted, would require a long time to complete and would cost a large sum of money."[6]

Whatever may have been the principal purpose of placing cameras in the hands of surveyors in the 1886 season there is no doubt about the existence of considerable photographic activity that year in the Rocky Mountain region. Klotz recorded in his diary for September 14, 1886: "Deville arrives, looking after the surveys, especially in British Columbia and is taking numerous photographs along the Canadian Pacific Railway through the mountains. Since about a year photography has become a hobby of his, experimenting in all ways and manners, the ultimate object being to obtain some cheap method for illustrating our reports by views of the country of which the reports speak. . . . I have illustrated my own reports the past two years with photographs and at my own expense. Soon after breakfast Dr. Deville was off with his camera . . . He developed one of my negatives to see how the "paper" plates had kept during the summer, and was well satisfied with it."[7]

It is quite likely that some of the photographs, contributed by Deville to the special exhibit at the 1888 meeting in Ottawa of the Association of Dominion Land Surveyors, were taken on the Surveyor General's western trip two years previously. His contributions were described as "Views along the line of the C.P.R. in British Columbia and at Vancouver, New Westminister and Victoria by Captain E. Deville; views of Mount Field, Mount Stephen, Cathedral Mountain and The Golden Stairs." Other contributions to this display were made by Dr. G. M. Dawson and William Ogilvie ("Yukon rivers") and by Dr. Bell ("Hudson Straits and headwaters of the Ottawa River").

In 1889 McArthur reported that he had established 25 camera stations and had taken 250 views in the course of his field work in the Rockies. He also mentioned that the plate

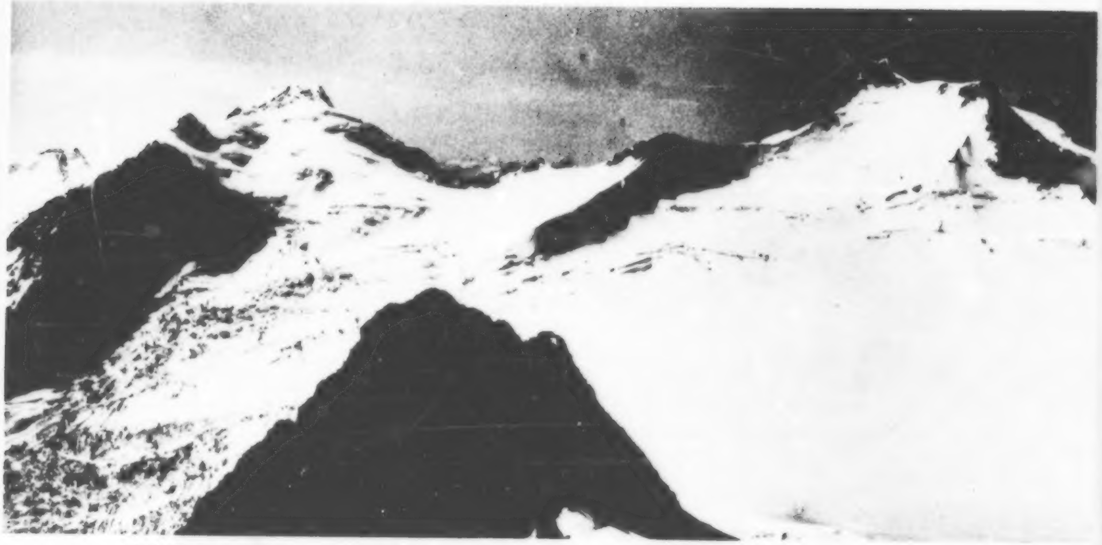


FIGURE 61. View from survey camera station by A. O. Wheeler in 1902, showing Mount Wheeler on right and Grand Peak on left, Glacier National Park, B.C.

used that season was "orthochromatic" and that it had given "decidedly better results" than what had been obtained in the previous season. W. S. Drewry, engaged in surveys in the New Westminister district of British Columbia, was similarly equipped with a camera in the 1887 season, although dense smoke from forest fires hampered him until September. On high ground Drewry referred to the fact that he used the camera "between snow squalls and got only half a dozen views."

Drewry graphically described an incident that occurred at this time, hair-raising in its implications yet only one episode in the hazardous life of a surveyor in the Rockies:

"On our way down we left the route by which we ascended and followed a cascade emptying into Harrison Lake near our own camp; in doing this we committed a grave error, as we soon found ourselves in a canyon with almost perpendicular sides; night approaching we had not time to retrace our steps, so that there was nothing for it but to push on. We worked cautiously downward hanging on to projections of rock . . . and, at last, after narrow escapes from loosened rocks and treacherous bushes . . . we emerged from the canyon . . . and vowed to attempt no more explorations while descending mountains."

But Drewry proved to be an enthusiastic convert to photography as an aid to surveys in the Rockies: "The more I study the mountains the greater is my conviction that a triangulation and photo-topographical survey is at once the best and the cheapest . . .".

In mountain regions the accuracy of the photo-topographic map depended primarily on the precision of the triangulation system controlling the survey and, therefore, upon the number of camera stations and of points plotted. The relative rapidity with which camera work could be completed on mountain tops was a definite advantage, especially in cold, windy weather. Generally it was possible to finish the task in two hours of observation. Re-occupation of the station was seldom necessary. With a plane-table, however, the story was different. The apparatus was more cumbersome to carry and much more difficult to keep stable under windy conditions.

In Canada and the United States the design of photo-topographic instruments was based upon the separation of the camera and the transit. This allowed for a very simple type of construction. In addition to the fact that complicated adjustments in the field were thus avoided, little risk was run of causing damage to instruments in their transportation. Survey cameras were inspected at the Survey Laboratory in Ottawa each year prior to their use in the field.

FIGURE 62
A. O. Wheeler

Deville considered that the precision of a photo-topographic survey was the same as that of a plan plotted with a very good protractor or with a plane-table. He pointed out that the number of points plotted by photography was much greater than by other methods. It was necessary, however, to find summits suitable for the establishment of stations and in sufficient relief to permit ready identification of the same point as viewed from various stations. The camera method did not prove nearly as useful in a region of heavily timbered hills.

Arthur Oliver Wheeler, F.R.G.S. (1860-1945), whose two-volume work, *The Selkirk Range** constitutes a unique record of photo-topographic surveys of 1901 and 1902 in the

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*Government Printing Bureau, Ottawa, 1905.

Selkirk Mountains area adjacent to the Canadian Pacific line, included in this publication detailed descriptions of camera survey operations in that rugged country. Born in Kilkenny county, Ireland, young Wheeler was educated at a Dublin private school. He came with his parents to Canada in 1876 and served as apprentice surveyor to Elihu Stewart of Collingwood, Ontario. Wheeler qualified as an Ontario land surveyor in 1881, as a Provincial land surveyor in Manitoba in 1882 and as a Dominion land surveyor in the same year. In 1891 he was commissioned a British Columbia land surveyor and in the same year, an Alberta land surveyor. In 1929 he was made an honorary member of the Dominion Land Surveyors' Association. His son, Sir Edward Oliver Wheeler (1890-1962), was a member of the graduating class at Royal Military College, Kingston, in 1910 (Sword of Honor Award). He became Surveyor General of India in 1941 and was knighted two years later. Early in 1921, when Wheeler, Jr. had joined the Mount Everest Reconnaissance Expedition as surveyor and photographer, he had used Canadian photo-topographic methods in detailed surveys of the Tibetan side of the world's loftiest mountain.

In a special paper delivered before an international gathering A. O. Wheeler described in detail preparations for his 1902 camera surveys.[8] His field party consisted of two assistants, two packers and a cook. When it became impracticable to employ pack ponies, the backs of the men were used to transport equipment and supplies. Instruments were carried to lofty summits, a task involving considerable danger. Crossings had to be made of treacherous, deeply crevassed snowfields and ice slopes. Avalanches were a constant menace. In order to peer into steep gorges and obtain working views the surveyors had to perch precariously on overhanging ledges and rock crags that provided only space enough to set up and operate instruments. In all 64 ascents of mountains were made in that field season, 17 of which were 9,000 feet or higher. The loftiest peak climbed was 11,113 feet above sea level. A total of 120 camera stations was occupied and 765 plates exposed.

In subsequent office work on these survey results Wheeler and his two assistants developed plates and made enlargements for plotting points, established correct elevations and produced a map, complete with contours. The time consumed on the entire project was 14½ months and the total cost amounted to $9,589.34.

The value of the camera as a survey aid in these experimental years was dependent upon weather and other conditions. Plates, while being exposed, had to be kept in a vertical plane. The position of the horizon and of principal lines had to be known as well as the focal length of the lens. Lighting was another important factor. Snowy peaks glistened in bright sunlight in marked contrast to surrounding deep, heavily timbered, shadow-filled valleys. The presence of a bluish haze or tinge often caused distant features to be indistinct, a condition known as "aerial perspective." From an artist's point of view aerial perspective, or indistinctness caused by distance, is desirable to convey the impression of remoteness. But to the surveyor such diffusion of light was most objectionable. In order to be of real value survey photographs had to be clear and full of details so that points to be plotted thereon appeared well-defined and easily identifiable.

The plate most frequently used in the pioneer years in Canadian topo-photography was a Wratten and Wainwright Panchromatic with a 'G' filter or yellow screen. This particular plate was sensitive to all light rays and, when used with a filter, gave satisfactory results. The screen reduced the effect of the most actinic part of the color spectrum—the ultra-violet to blue rays. In this way the obscuring blue haze was removed and distant points registered distinctly.

With his theodolite the surveyor located his camera stations and made any required secondary triangles as well as measuring the azimuth of at least one well-defined point for each photograph. From this azimuth the direction of the principal point was deduced.

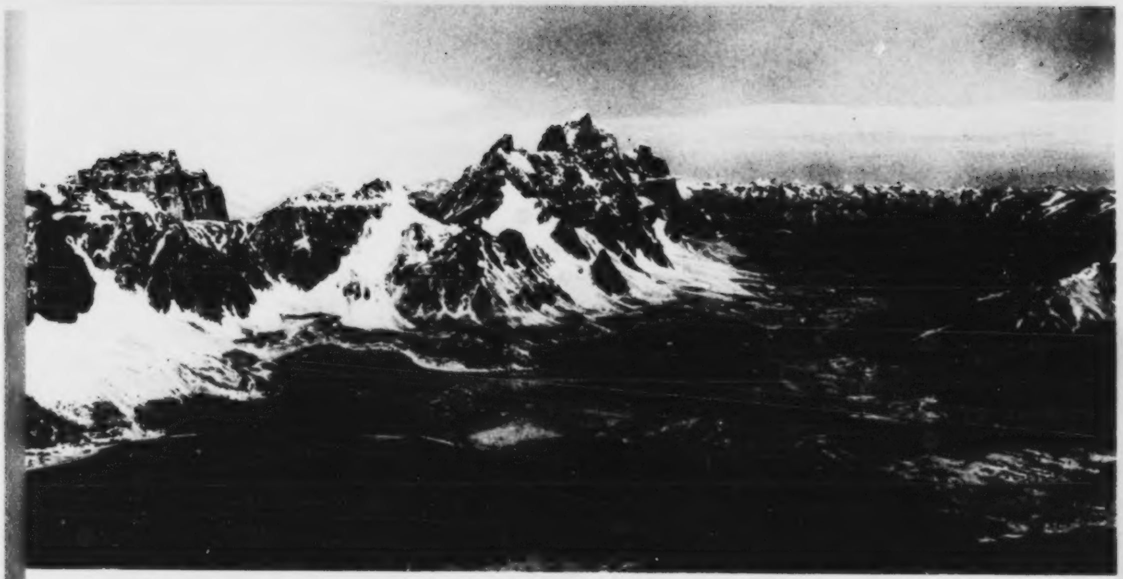


FIGURE 63. View from survey station on Mount Clitheroe by M. P. Bridgland. Mount Geikie in centre, Tonquin Pass, and Amethyst Lake in foreground, Jasper National Park.

The lens in the survey camera was a Zeiss anastigmat. By means of a screw the photographic plate was brought into contact with edges of the camera box so that focal length was invariable. Horizon and principal lines were indicated by notches in the edges.

Having plotted his triangulation and camera stations the surveyor took a photograph and after finding the azimuth of his principal point, drew it on his plan. At a distance equal to the enlarged focal length he drew a perpendicular which formed the ground line. He repeated the construction for another photograph covering the same scene. Then he placed the two photographs before him and selected a number of points which could be identified on both views. He assigned a number to each point. The directions were next plotted on the plan, the altitudes being obtained by geometrical principles.

Climbing high mountains called for rugged endurance and alpine skills of a fairly high order. On lower slopes dense underbrush and windfall greatly impeded progress. At higher levels snow-covered slopes, glaciers and steep rock cliffs made travel hazardous and arduous. Many surveyors under these trying conditions suffered severely from the cold and high winds.

Sudden shifts in lighting conditions after the summit was reached were also frustrating. Rapidly moving clouds meant almost continuous variations. Storms came up quickly, often without any warning signs and camera-work had to be conducted with speed and precision. Smoke from forest fires as well as early snowstorms provided additional obstacles. Accordingly any successes achieved by the photographic surveyor in the Rocky Mountains depended largely upon his ability to obtain serviceable photographs under the most adverse conditions imaginable.

In this type of field work the country to be mapped had to be viewed from at least two points that subtended angles large enough to give satisfactory intersections yet not too great to permit easy recognition of the same points as these appeared on corresponding photographs, taken in pairs, from each camera station. For plotting purposes enlargements of 10 inches by 14 inches were made from negatives. Enlarging work was done at the surveys office in Ottawa. Dennis, in his short history of federal surveys, mentions that by April, 1887, the task of developing and enlarging surveyors' photographs had reached such proportions as to call for the appointment of a professional photographer at headquarters in the person of H. N. Topley.[9]

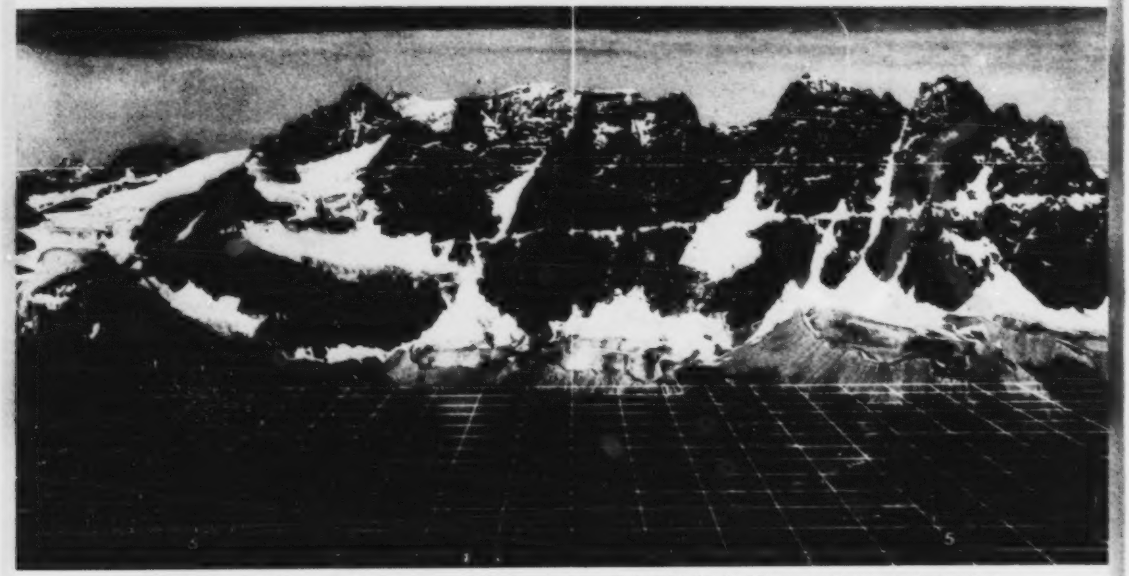


FIGURE 64. The Ramparts, Jasper area, photographed by M. P. Bridgland, with survey lines superimposed on the view to aid in mapping. Features are plotted by means of the squares.

The convenience of completing topographical work in an office environment, rather than in the field, turned the balance of choice in favor of the camera method. In addition the plane-table technique made considerable demands on the memories of surveyors, a factor not present in photo-topography. Photography possessed solid advantages as well in the varied processes which principles of perspective placed at the disposal of topographers. The success of the newly-adopted system rested to a large extent upon a thorough knowledge of descriptive geometry and perspective.

In the Ottawa office triangulation was plotted by orthodox methods, depending on the nature of the control. This might vary from precise triangulation to a reconnaissance survey while the triangulations and photography were carried on at the same time. Elevations of mountain peaks were completed from angles read in the field. Necessary corrections were made for curvature and refraction. A selection was made of views taken from a number of camera stations, relating to the same area. Points on corresponding views were identified to reveal the topography and were then plotted on the plan. Using these points as guides the topographer, with the photographs before him, was able to draw in the contours. The accuracy of his work was dependent chiefly upon the number of points plotted and the scale of the plan.

Relatively level features such as swamps, lakes and rivers were plotted by means of squares. The perspective of a series of squares was laid down and the projection, on the required scale, was drawn on the plan. The various features were then drawn on the projection, square by square. The squares were made sufficiently small to provide good definition. In practice the squares were not ruled on the photographs but produced with an instrument called a perspectometer.

The work of plotting points and drawing contours required, as a rule, twice as much time as the field work involved. There was no need for the photographer-surveyor to plot or make measurements. This was done by office staff. Though this was a tedious operation it was not subject to the sort of interruptions all too often experienced in the field. On occasions such interruptions took on the aspects of near-tragedy. For example, on Alaska-British Columbia boundary surveys in early October, 1907, a canoe used by the Canadian party foundered when it struck a submerged snag on the Iskut River. Five occupants of the craft reached shore with difficulty but contents of the canoe, including several valuable instruments and a priceless box of 96 exposed photographic plates were lost. Every effort was made to recover the plates but to no avail, even though a small party remained for a 10-day continuation of the search following the departure of the main party down river to Wrangell.[10]

Relative costs of the two operations were a consideration also in the decision to use photo-topography. In *Photographic Surveying* Deville estimated the total cost of 8 days in the field with plane-table equipment at $164 in comparison with 2 days in the field and 3 days in the office based on camera work at a total cost of $56. In another connection he cited the cost of a satisfactory topographical map of a mountain region, based on triangulation and photography as from 2½ to 4 cents per acre. A survey party of seven men was regarded as the commonly accepted number for work in mountain regions. The party chief and his assistant, each equipped with a camera, were accompanied by five others including a cook and two expert packers where pack horses were used. In districts particularly difficult of access, extra men might be required.

Intangible rewards were enjoyed by adventure-loving surveyors in this type of work. A well-known British Columbia surveyor has eloquently described this sense of elation in achievement: "Having climbed to these high stations at considerable physical effort and sometimes at some risk, I know well the thrill of viewing the august panorama of other peaks circling the horizon . . . to see, here and there, peaks one has known before and, occasionally in the dim distance . . . big fellows one has . . . climbed years ago. It is like re-encountering old friends . . . and by this widening circle of alpine landmarks one's knowledge of the country is enhanced and takes form."[11]

Until 1892 Canadian photographic surveys were confined to the areas in the Rocky Mountains in the vicinity of the main line of the Canadian Pacific Railway. In 1892 the International Boundary Commission decided to examine the country along the Alaska-British Columbia boundary. The Canadian commissioner on this special assignment was W. F. King, who decided to perform his share of the international work by photo-topographical methods. In 1893 and 1894 seasons this project covered 5,000 square miles.

Irrigation surveys in southern Alberta on which the camera was employed, began in 1895 under the direction of A. O. Wheeler. In addition to stream gauging and the establishment of bench marks, it was necessary to ascertain locations of catchment areas and to define sites for reservoirs. Photography on the eastern slopes of the Rockies possessed a distinct advantage in relation to the planning of irrigation projects. By ordinary survey practices the suitability of any reservoir site could not be definitely ascertained until the area under investigation was at least partly plotted. This involved a preliminary survey. If, after plotting, the site was judged to be favorable for the purpose, the topographer had to go over the ground a second time in order to make a detailed survey. When the camera was employed, however, it was only necessary to plot the plan to a certain point. Photographs provided a general plan, furnishing all topographic details required. A second examination of the area was unnecessary. Whether or not, in the final analysis, a reservoir site was considered suitable, expenditures of extra time, money and work were avoided.

In several important aspects of early surveying in Canada Deville was far ahead of his time, but in his authoritative book he quite failed to envision the extensive possibilities of air photography in Canada. Admittedly at the time he wrote *Photographic Surveying* the

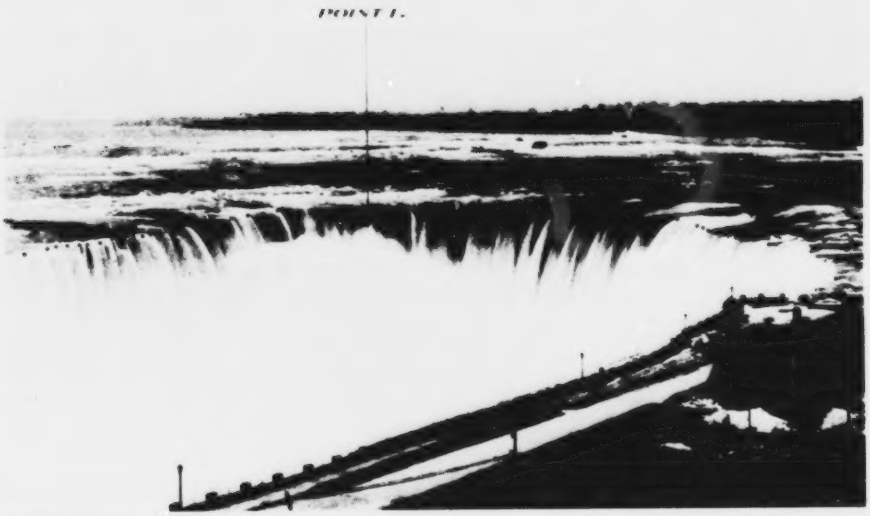


FIGURE 65. View of Niagara Falls during the photographic survey to determine rate of recession at brink, 1927.

fixed type of aircraft remained a profound secret in the womb of the future. But surveys had been made from balloons, using cameras. Deville expressed doubt, however, that the method would ever amount to anything more than a topic of theoretical interest. To his land-bound surveying mind the experiment appeared to be in the nature of a stunt. He was content to observe that the balloon procedure required an entirely new system of surveying by means of photographs taken on plates placed horizontally, or nearly so. "Of course," he conceded, "it is doubtful whether the method will ever be found practical."[12] Deville's early misgivings dissolved in the light of subsequent experience and he lived to see, as well as to take an active part in promoting, a formidable revolution in Canadian surveying and mapping, brought about by the development of heavier-than-air flying machines.

Perhaps the most impressive single application of the Deville photo-topographical system in Canada was the survey made of Niagara Falls by vertical air photography in order to determine the rate of recession at its brink. This survey was performed by W. H. Boyd, Chief Topographical Engineer, Geological Survey of Canada, in April, 1927. Prior to this understanding the customary method of surveying employed by those engaged in this feat of measurement was instrumental intersection for the determination of points along the edge of the falls. Instruments used in this regard were the surveyor's compass, transit and telescopic alidade. However, because of the huge masses of water flowing in swift motion and the constantly changing appearance of the torrents, it was exceedingly difficult to fix definite points along the brink with any assurance. It was decided, therefore, to use the photo-topographical method of survey. In photographs it proved to be much easier to judge the approximate position of a rock crest under such obscuring conditions, especially in relation to curved surfaces of water in rapid movement.[13]

Summing up achievements under the Deville system it should be pointed out that Dominion land surveyors McArthur, King, Wheeler and Bridgland, with the related work of A. J. Campbell and R. E. Harris, during field seasons extending from 1886 to 1906 and from 1911 to 1923, mapped a total of 20,950 square miles, using the camera as a surveying aid.

Reconnaissance and other land surveys in British Columbia and Alberta from 1904 to 1923, under the Geological Survey of Canada, employing photo-topographical methods, were performed by D. A. Nichols, F. S. Falconer, K. G. Chipman, W. H. Miller, R. Bartlett and A. C. T. Sheppard. These surveys covered more than 13,000 square miles.

Under the authority of the government of British Columbia similar surveys were conducted in that province covering 6,474 square miles and performed by R. D. McCaw and G. J. Jackson in field seasons from 1913 to 1922. In accordance with programs organized by the International Boundary Commission and the Geodetic Survey, Department of the Interior, King, McArthur, J. D. Craig and D. A. Nelles topo-photographically surveyed a total of 7,400 square miles along the Alaska-British Columbia boundary.[14] Other Dominion land surveyors who were engaged on this boundary work during the same period included W. F. Ratz, George White-Fraser, D.T.S., A. J. Brabazon, C. A. Bigger, Fred Lambart, E. J. Rainboth and A. G. Stewart.

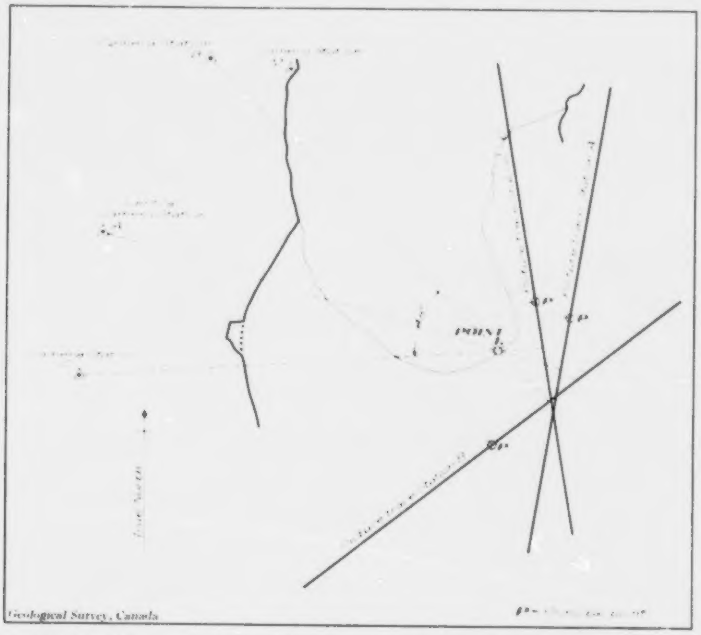
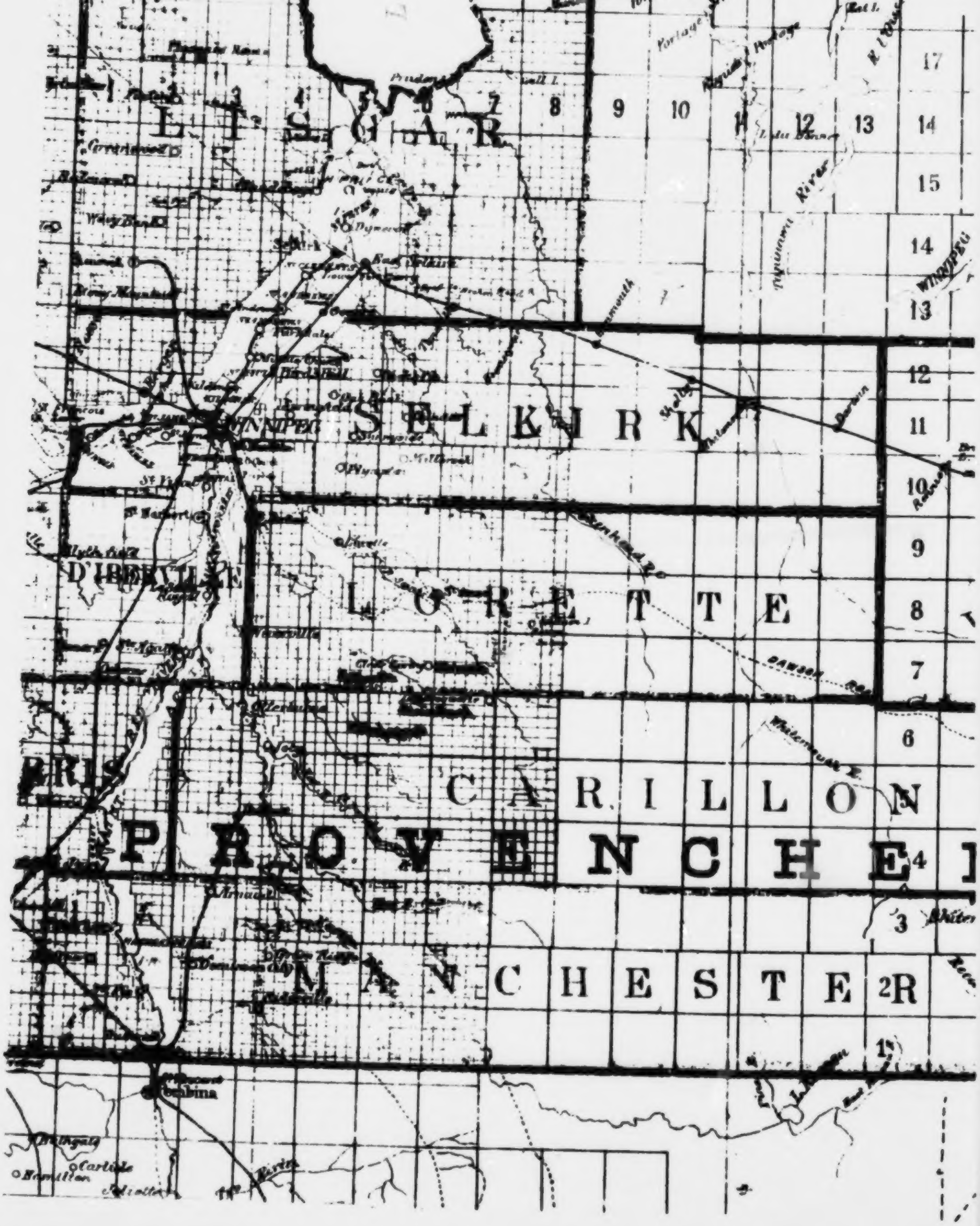


FIGURE 66. Diagram showing set of camera stations at Horseshoe Falls, established for purposes of the 1927 camera survey.

Deville's exceptional appreciation of the value of camera work in surveying and mapping was not limited to photography in the field. He was also keenly interested and involved in the improvement of map reproduction techniques and in the special function of the camera in producing copies of maps and plans required by surveyors for field use and for other purposes. This function is not to be confused with the printing of maps by various processes of photo-lithography, photo-zincography and photo-engraving. During the early years of the 20th century the copying camera became basic equipment in all survey establishments in Canada. Deville designed a Canadian version of this equipment and worked out a system of ratios in terms of percentages for guidance in reducing and enlarging processes. His mastery of the geometry of the copying camera remains unique in this country.[15]

In the words of this inventive and resourceful Surveyor General "nowhere has photography proved more useful than in survey departments." It should be added that no Canadian made a more valuable or more inspired contribution to the development of practical applications of the camera to the tasks of surveying and mapping than did Edouard Gaston Daniel Deville. Deville, in effect, introduced in this country a special type of terrestrial photogrammetry, a venturesome innovation marking the first application to Canadian conditions of the photogrammetric art. In the half-century following Deville's pioneer work, photogrammetry, in a variety of aspects and by gradual stages, became widely accepted as an efficient, economical method of making survey measurements through the use of photographs.


PRINCIPAL MERIDIAN
LAKE WINNI
Black R.
Fort Alexander
Portage
Silver Falls
Bear L.
L I S G A R
S E L K I R K
WINNIPEG
D'IBERVILLE
L O R E T T E
C A R I L L O N
P R O V E N C H E R
M A N C H E S T E R
Pembina
Carlisle
Hamilton
22
21
17
14
15
14
13
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10
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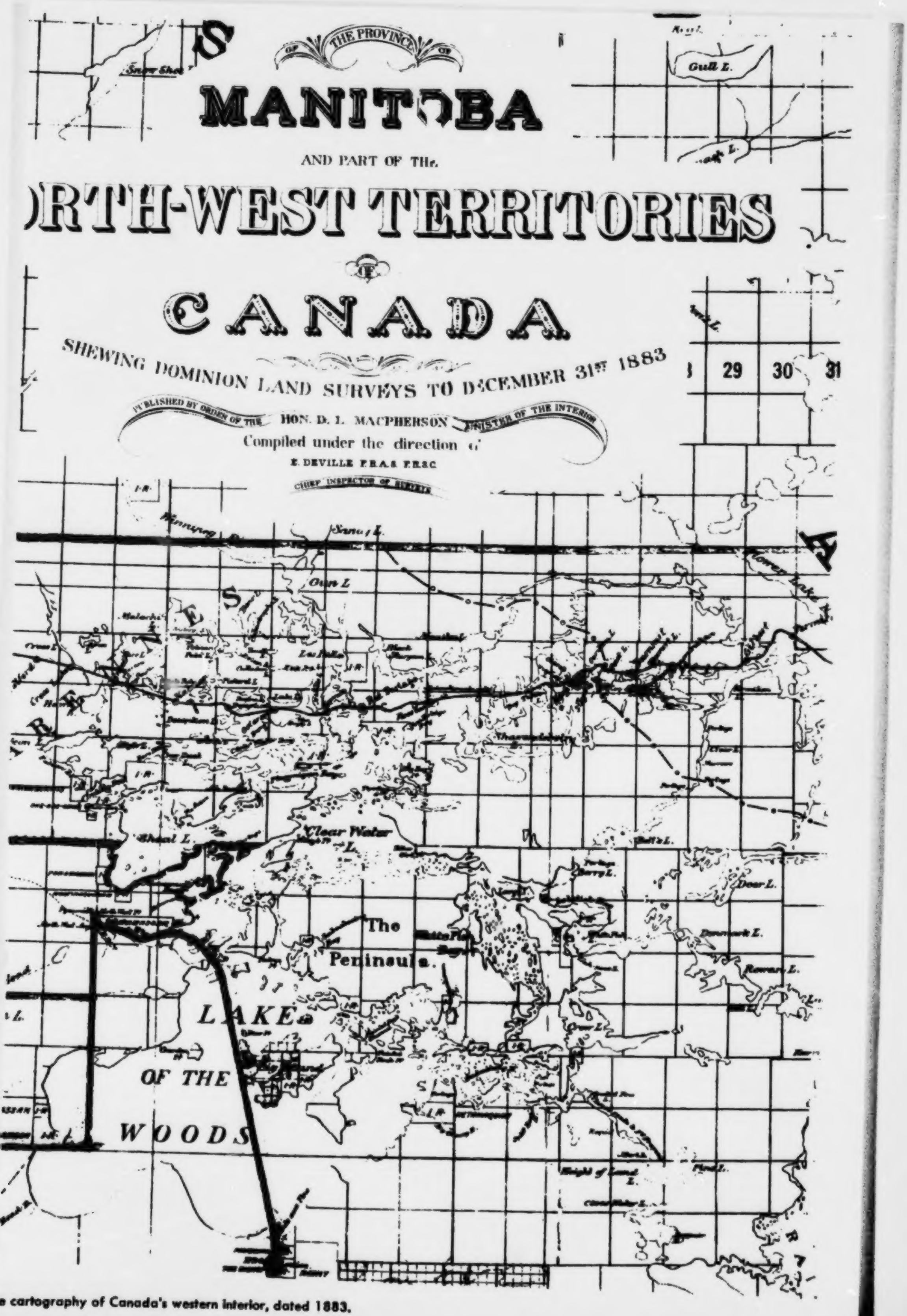
MAP 11. Portion of Deville's map, a mileston


THE PROVINCE OF
MANITOBA
AND PART OF THE
ORTH-WEST TERRITORIES
OF
CANADA
SHEWING DOMINION LAND SURVEYS TO DECEMBER 31ST 1883
PUBLISHED BY ORDER OF THE HON. D. L. MACPHERSON MINISTER OF THE INTERIOR
Compiled under the direction of
E. DEVILLE F.R.A.S. F.R.S.C.
CHIEF INSPECTOR OF SURVEYS
Gull L.
29
30
31
Clear Water L.
Shoal L.
The Peninsula.
LAKE OF THE WOODS
Deer L.

e cartography of Canada's western interior, dated 1883.

9

THE YUKON GOLD RUSH AND WILLIAM OGILVIE, D.L.S.

"But mark how he bears his course . . ."
King Henry IV (1), Act 3, Sc. 1

William Ogilvie (1846-1912) had a very active surveying career in Eastern Canada, the Mid-West and the Far West. But his principal claim to lasting fame rests upon his notable achievements as an explorer, boundary-line surveyor and administrator in the Yukon Territory.

Article III of the British-Russian treaty of 1825, that determined the boundary between the territories of the contracting parties in Northwestern North America, provided in part that the line " . . . shall ascend to the North along the Channel called Portland Canal as far as the 56th degree of North Latitude; from this last-mentioned point the line of demarcation shall follow the summit of the mountains situated parallel to the Coast, as far as the point of intersection of the 141st degree of West longitude [of the same meridian] and, finally, from the said point of intersection, the said meridian line of the 141st degree, in its prolongation as far as the Frozen Ocean, shall form the limit between the Russian and British Possessions on the Continent of America to the North-West."

The first Canadian effort to define officially part of the boundary line thus described, following the purchase of Alaska from Russia by the United States in 1867, was made by Joseph Hunter, a civil engineer, of Victoria. In 1877, just one year after Custer's tragic last stand against Indians on the Little Big Horn River, Hunter was appointed by the Canadian government to make a partial survey of the Stikine River and to mark the boundary line along it. His work was confirmed in 1903.

In 1887 Ogilvie was authorized by Ottawa to head an expedition to locate as definitely as possible the 141st meridian on the Yukon River. This action heralded the first direct attempt to fix with precision the Canada-United States boundary line in that part of North America.

William Ogilvie, the man entrusted with this highly important mission, was born at Glen Ogilvie, now Cyrville, on the eastern outskirts of present-day Ottawa. His grandfather William, who had come to Canada from Scotland, established this tiny settlement in the 1840s. In 1869, at the age of 23, the grandson of the same name began practice as an Ontario land surveyor. There are records of some of his earliest surveys, made for the federal Public Works Department in 1870 and 1871. In those seasons Ogilvie headed a field party of six men, commencing work on the line between the 7th and 8th concessions of Gloucester township, not far from Ottawa. Ogilvie was one of a considerable number of provincial surveyors who were blanketted in as Dominion land surveyors, without taking any formal examinations. Their commissions dated from April 14, 1872, in accordance with the terms of the Dominion Lands Act of that year.

For a period of 12 years, from 1875 to 1887, Ogilvie performed surveys on behalf of the Department of the Interior in Canada's North West as far as the Peace River and Mackenzie River areas, as well as pioneer surveys in the Railway Belt of British Columbia. In his reminiscences Ogilvie wrote that he left Ottawa in May, 1875, for Fort Garry "recently rechristened Winnipeg but still more generally known by the former name." Three years later he was sent to Battleford, then the newly-named capital of the North-West Territories, for the purpose of fixing its latitude and longitude. It was on this mission that Ogilvie claimed he saw a herd of more than 10,000 bison.

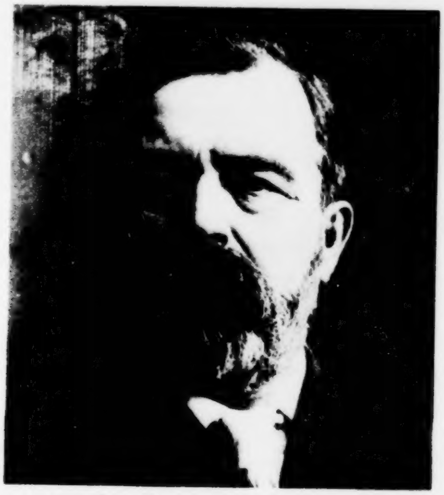
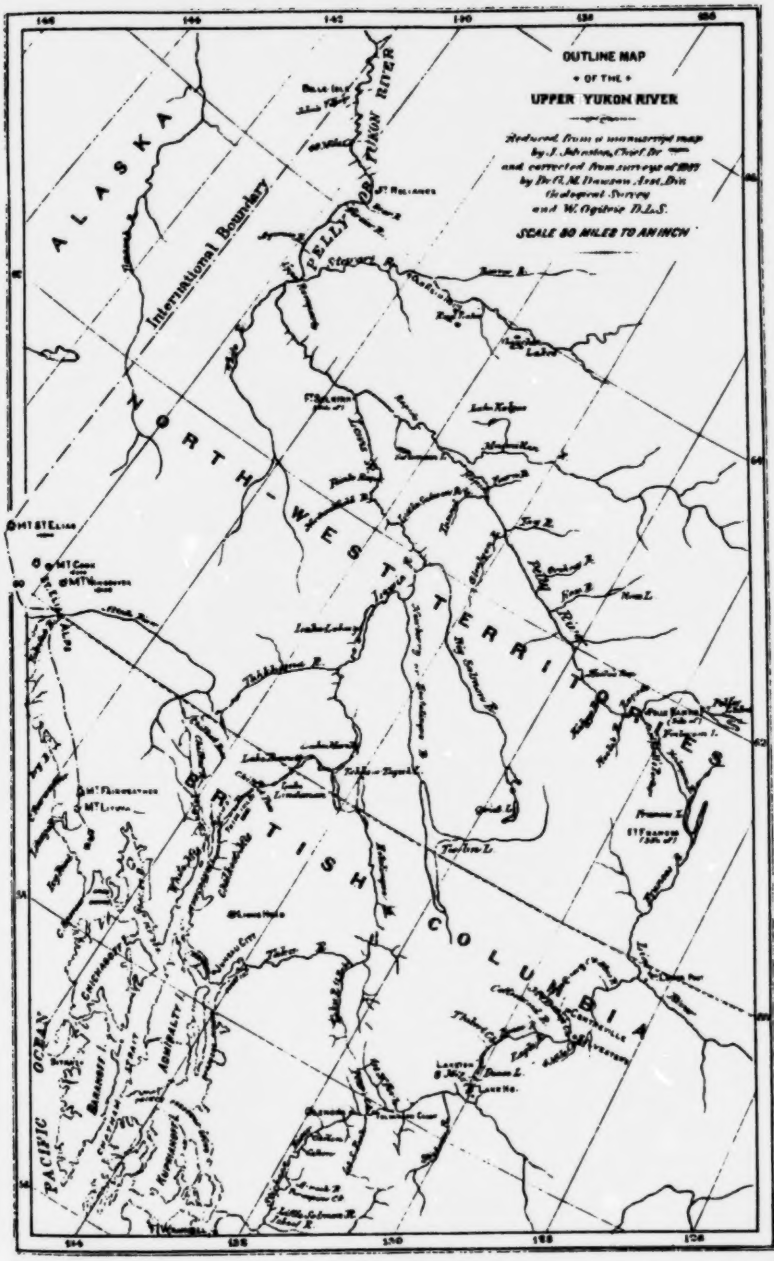


FIGURE 67
William Ogilvie.

Ogilvie described in memorable terms a contest he observed involving two Indian buffalo hunters. "One of them", he wrote, "was armed with a modern Winchester of that period, a very light . . . weapon: the other, with a single barrel shotgun sawed off short. Each was mounted on a perfectly trained hunting horse. The Winchester carried 17 cartridges in the magazine and one in the barrel, making a total of 18 which could be shot by an expert in as many seconds.

"The other Indian with his old-fashioned muzzle-loader might consider himself fortunate if he fired a shot a minute . . . To reload the Winchester was the work of an instant—with the old shotgun it was a feat worth seeing. The powder was carried in a horn slung by a string over the shoulder, the charge poured from it into the palm of the left hand, the gun brought up with the right [hand] and the charge transferred to the muzzle. A bullet carried along with others in the mouth, spat into the gun, and sent home by rapping the butt sharply on a part of the saddle, a cap placed on the nipple completing the loading.

"The result—all 18 shots fired from the Winchester into the side of a buffalo, it continued its way apparently little the worse for the fusilade, while the man who fired the sawed-


OUTLINE MAP
OF THE
UPPER YUKON RIVER
Reduced from a manuscript map
by J. Johnston, Chief Dr
and corrected from surveys of 1887
by Dr G. M. Dawson Asst. Dir.
Geological Survey
and W. Ogilvie D.L.S.
SCALE 80 MILES TO AN INCH
ALASKA
International Boundary
NORTH-WEST TERRITORIES
BRITISH COLUMBIA
PACIFIC OCEAN
YUKON RIVER
PELLY OR
Stewart R.
Teslin Lake
Lake Lebarge
MT ST ELIAS
ADMIRALTY
Dease L.
Frances L.
Liard R.
146
144
142
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128
126
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62
64
58
56

FIGURE 68. Map of the Upper Yukon River incorporating results of 1887 surveys by G. M. Dawson and W. Ogilvie.

off shotgun was fortunate enough to send his animal tumbling head over heels at the third shot—and won the contest."[1]

On September 10, 1878, Ogilvie reached Blackfoot Crossing on the Bow River. At this place some 700 Blackfoot Indians had assembled with their venerable leader, Chief Crowfoot. Some mischief-maker had notified the Indians that surveyors were coming to lay out the boundaries of their reserve and in the process would "erect a high wall that would last forever as a barrier" between the Indians and the outside. No matter what Ogilvie and his party members tried to do, the Indians prevented him from starting his survey. Ogilvie, unaware of the reason for their animosity, was at a loss over how to proceed with his official task. The natives would not even permit the white men to build a fire. Caught in this strange impasse Ogilvie was encouraged greatly to hear one of the Indians say something in French. "I could make myself fairly understood in that language", Ogilvie recounts, "and I inquired for Chief Crowfoot, letting it be known that I wanted to satisfy him what was to be done in regard to the survey." Fortunately the French-speaking Indian could speak English and the Blackfoot dialect as well. As a result Ogilvie soon came to an understanding with the old chieftain. Crowfoot instructed his people that Ogilvie was to be allowed to carry on his official work without any hindrance.[2]

Ogilvie, in commenting on travel conditions in the western interior in 1882, stated that the journey from Calgary to Edmonton then occupied ten days! In 1891, returning to Ottawa from a trip down the Mackenzie River to the Liard and from the headwaters of the Nelson River across the watershed to the Peace River at Fort St. John, Ogilvie remarked that he had railway transportation all the way to Ottawa from Edmonton, a real novelty.

It was in 1887, on his boundary locating mission, that Ogilvie first saw the Yukon Territory, the land that was to win his deep affection. Within a few years it won the attention of the world. He was under instructions from Surveyor General Deville to survey the Yukon and Pelly Rivers and to define the point where the 141st meridian (Alaska-Yukon boundary) intersected the Yukon River. Up to this time such an expedition represented the most important and extensive exploratory survey ever undertaken by the Department of the Interior. Its results were eagerly awaited by Ottawa. Ogilvie left Victoria on May 13, under the direction of Dr. G. M. Dawson, then Assistant Director of the Geological Survey of Canada. The journey to his observatory point on this survey occupied the greater part of the 1887 field season.

It was while he was at Juneau on his way north that Ogilvie heard reports of a low mountain pass from the head of Chilkoot Inlet to the headwaters of the Lewes, later known as the Yukon River. Local Indians seemed secretive about the pass but ultimately an Indian from the interior, one who had travelled the area previously, was induced to act as guide for Capt. William Moore, who accompanied Ogilvie on this journey. Ogilvie has recorded that he incorporated the information gained by Moore's sortie "in my plan of survey from Dyia Inlet . . . I have named this pass 'White Pass' in honour of the late Hon. Thomas White, Minister of the Interior."[3] It was during White's term of office that the Ogilvie expedition was authorized.

Two years after the purchase of Alaska by the United States, Professor George Davidson, of the United States Coast and Geodetic Survey, made a reconnaissance survey and determined the latitude and longitude of a point on an island in the Chilcat River. Using this established point as an anchor for his own subsequent surveys Ogilvie carried his survey line over the summit of the mountain chain to Lake Bennett, reaching the locality of the 141st meridian on the Yukon River in mid-September, having covered 640 miles since his disembarkation. This point was near Fortymile River, a tributary of the Yukon, some 60 miles northwest of present-day Dawson, a settlement named by Ogilvie in tribute to Dr. G. M. Dawson.[4]

Ogilvie employed two canoes, the crew of one craft working ahead of the other and picking out sites favorable for observation stations. At each station they would land, set up a base rod and wait until the bearing of it in degrees, minutes, and seconds of arc from the preceding station was read by Ogilvie or his assistant. This operation was repeated throughout the working day. Distance was calculated by trigonometry. The topography along the Yukon River was given as well as its length from point to point. On reaching the vicinity of the boundary, winter quarters were established. Ogilvie settled into his winter-long, extremely arduous task of obtaining all the astronomical observations he could on the position of the 141st meridian west of Greenwich in that neighborhood. Lacking a telegraph line for determining longitude with precision, his only resort was to make observations on the moon. Two methods were open to Ogilvie in this regard, one, that of ascertaining the exact local time when the moon occults (eclipses) a star, the other, that of obtaining the exact local time when the moon crossed the meridian of the observation place.

Before he left Ottawa Ogilvie and Chief Inspector of Surveys W. F. King had arranged that he would observe a series of star eclipses (by the moon) in the vicinity of the International Boundary line where it intersected the Yukon River. Because of cloudy, stormy weather this method proved ineffective. So Ogilvie was compelled to use moon culminations or crossings over the meridian. From November, 1887, to February, 1888, Ogilvie obtained 22 such transits of the moon. The hardships he endured in the observing process were trying in the extreme. All of the observations were taken in an unheated cabin through a slot in the roof. This precaution was essential since any artificial warmth would have caused waviness of the star or lunar images. Some of Ogilvie's observations were taken when the temperature was 50 below zero, often when the temperature was 40 below zero. Very seldom, in fact, was the cabin warmer than 30 degrees below!

Ogilvie's principal instrument on this expedition was rather primitive by comparison with 20th-century standards. The telescope was that of a small portable astronomical transit mounted on an improvised base. The original mounting weighed at least 400 pounds, which rendered its conveyance to the field inadvisable, if not quite impossible. By designing his own "set of brasses" to be placed on a suitably wide tree stump, his travel weight was reduced on this item to 80 pounds. A three-day hunt was required to find a tree in the locality possessing the required diameter. Actually the position of the tree determined the site of the winter quarters on Fortymile River. The stump, in the event, proved to be on a steep hillside and it swayed noticeably with temperature changes. Thus it was seldom stationary and had to be levelled every evening before observations could be taken. At the conclusion of these precarious operations, aided by references to compiled mathematical tables, the resulting position of the meridian was marked by cutting a line through timber stands north and south of the river for a considerable distance. Then a survey was made upstream on Fortymile River and the boundary line marked accordingly.

In 1907 Canadian and American survey parties, employing the star-transit and electric-telegraph method, fixed the meridian line on a true location only several seconds removed from the position established 20 years before by Ogilvie. At the time Ogilvie had only one chronometer which, although a good product, was unequal to the strains placed upon it by extremely low temperatures. He had reason to deplore his lack of a second watch. He could have kept this in the cabin at a relatively uniform temperature so that the timing of the watch used in actual observing could be compared in the interests of greater accuracy.

Ogilvie once told a friend how, on one disturbing occasion, he had lost a gold watch presented to him by the National Geographic Society of Washington, D.C., in recognition of his explorations in the North West. He was crossing a small northern lake with two Indians. They paddled the canoe in the centre of which Ogilvie sat trolling. In some curious way he dropped his priceless but chainless watch overboard in the deepest part of the lake. He was greatly distressed by this loss and as the day was nearing sundown, he established camp on the lakeshore with the intention of searching for the watch next day. Accordingly he took bearings to locate the exact place of his accident. Next morning when he went to the beach to wash, while the Indians cleaned fish that had been caught the previous day, Ogilvie noticed a small pike that had been tossed back into the lake and that was behaving in a strange manner, swimming in circles close to the shore with its tail extended upwards. Investigating at closer range he discovered wedged in the fish's throat his gold watch, still keeping good time.[5]

Three fur traders of outstanding importance were active in the Yukon at a time when gold miners began prospecting the territory. They were N. L. "Jack" McQuesten, Arthur Harper and A. H. Mayo. In one way or another these men were associated in trading ventures. Fortymile River and Sixtymile Creek were named to indicate the estimated distance of the mouths of these streams from Fort Reliance, established by McQuesten in the 1870s on the Yukon River about 6 miles below present-day Dawson. Harper, in the early 1890s, built a trading post opposite the mouth of Sixtymile Creek, naming it "Ogilvie" after the surveyor.

The Klondike River, flowing from the east into the Yukon River opposite Dawson was, according to Ogilvie, known to natives of the region as 'Tron-diuck' or 'hammer-water' in their Indian dialect. This had reference to the fact that in order to place nets across its mouth to capture salmon, stakes had to be hammered into the gravel bed of the stream. Later Ogilvie referred to another version of the Indian name, e.g., 'Troan-dike' from which, it is surmised, the English name is derived. On September 1, 1887, Ogilvie, on his initial glimpse of this area, reported that the principal industry of the district was salmon-trapping. Nine years later this unspectacular fish-stream was suddenly transformed into a throbbing hive of mining activity quite unmatched in the long story of man's search for gold.

During the winter of 1887-88 many miners visited Ogilvie's cabin. Aware of his status as a government employee and, to some extent, as a representative of the federal government in the district, the men sought information on the attitude of Ottawa concerning the application of mining laws and regulations to the Territory.* The special rigors of the climate and the special problems presented, in particular, by permafrost demanded a larger size of discovery claim than that commonly provided elsewhere within Canada. Views expressed by these miners to Ogilvie, on this and related matters, were incorporated in a memorandum and conveyed by him to Ottawa. He advised his superiors that the size of creek claims ought to be at least 300 feet in length and extend completely across a valley bottom.

When Ogilvie reached Ottawa in January, 1888, he was relieved to find Interior Minister White and his deputy, Burgess, were eager for information about the Yukon. It was on Ogilvie's advice in September, 1893, that the exercise of Canada's jurisdiction at the boundary mining camp at Fortymile was formally undertaken by Capt. Constantine of the Royal North West Mounted Police. This officer was the forerunner of a total force of 20 "mounties" sent the following year to maintain law and order in the region. In 1895 the Yukon was made a provisional district of the North-West Territories and in 1898 it became a separate Territory, with Dawson as its capital. A Commissioner was appointed as a governor of the Yukon and he was advised by a Legislative Council of six members.

In the beginning Yukon gold miners were content to use a simple "rocker" and their

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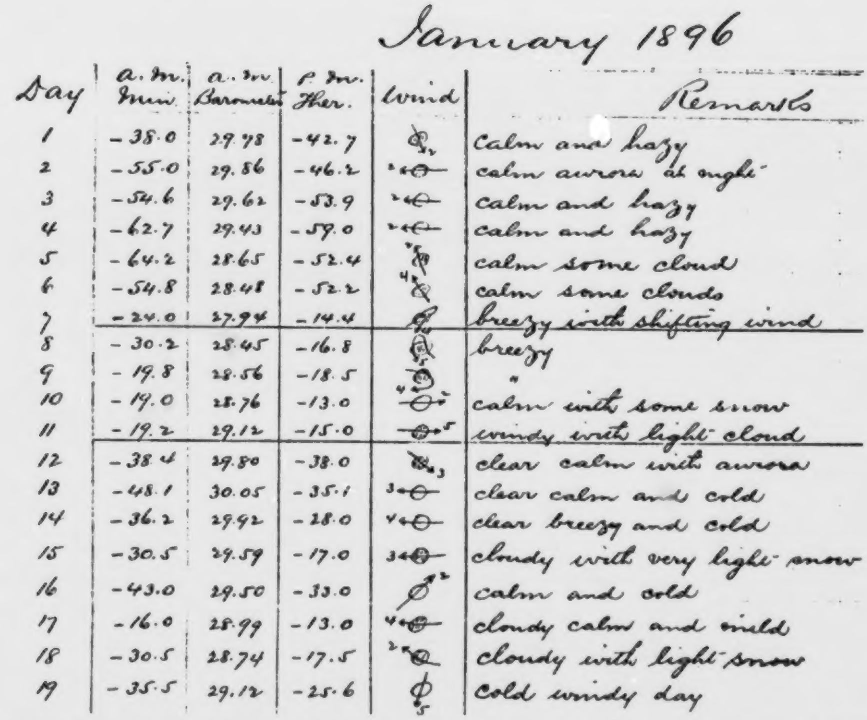
*On April 14, 1887, Ogilvie was appointed Commissioner of Police within British Columbia and the North-West Territories. His powers in this role were never clearly defined and for the most part he was content to let these remain largely dormant.



January 1896

Day	a. m. Min.	a. m. Barometer	p. m. Ther.	Wind	Remarks
1	-38.0	29.78	-42.7		Calm and hazy
2	-55.0	29.86	-46.2		calm aurora at night
3	-54.6	29.62	-53.9		calm and hazy
4	-62.7	29.43	-59.0		calm and hazy
5	-64.2	28.65	-52.4		calm some cloud
6	-54.8	28.48	-52.2		calm some clouds
7	-24.0	27.94	-14.4		breezy with shifting wind
8	-30.2	28.45	-16.8		breezy
9	-19.8	28.56	-18.5		″
10	-19.0	28.76	-13.0		calm with some snow
11	-19.2	29.12	-15.0		windy with light cloud
12	-38.4	29.80	-38.0		clear calm with aurora
13	-48.1	30.05	-35.1		clear calm and cold
14	-36.2	29.92	-28.0		clear breezy and cold
15	-30.5	29.59	-17.0		cloudy with very light snow
16	-43.0	29.50	-33.0		calm and cold
17	-16.0	28.99	-13.0		cloudy calm and mild
18	-30.5	28.74	-17.5		cloudy with light snow
19	-35.5	29.12	-25.6		Cold windy day

FIGURE 69. Page from Ogilvie's 1895-96 Yukon field book showing the typical systematic neatness of his weather records.

operations were confined to river banks and gravel bars. But frequently the best pay dirt extended into deep water and out of easy reach. The practice grew, therefore, of removing parts of river ice in spring months and of building fires on the river-bottom gravel, thawing it, and piling it in dumps preparatory to sluicing operations in the warmer months.

Ogilvie advocated a new principle in this process and by its adoption a stronger impulse was imparted to gold mining generally in the Yukon. The proposal was to thaw a hole down to bedrock where coarse gold, the type of deposit most prized by miners, could be obtained. This single improvement substantially widened the production capacity of territorial streams. Another significant improvement urged by Ogilvie was the use of steam, with the aid of a boiler and hose and a pressure at the nozzle of forty pounds, for rapid softening of frozen clay or gravel. The steam method, in fact, came to be commonly used on all placer claims in the Yukon Territory.

In the winter of 1895-96 Ogilvie, after building a new observatory cabin to replace the original which had been damaged by fire, set about the task of extending the 141st meridian (boundary) line north from Fortymile River. His only precision instrument was an astronomical transit. His ordinary line transit was a 3-inch instrument designed for mountain work. It was necessary for Ogilvie to produce a series of traverse lines with this latter instrument extending from the observatory to the boundary line, a distance of some 3 miles, and in this manner to originate his boundary extension survey. For the two months that he worked on this project he failed to sight a star on his transit. Accordingly the line was run for 50 miles without there being any opportunity to check for accuracy. With his tiny instrument the line was extended from peak to peak, sometimes separated by many miles. At almost every station the horizon was photographed completely in accordance with the new Deville system. This procedure resulted in a fairly accurate map of the 20-mile strip along the boundary line, 10 miles on each side. In addition the position and elevation of some remote peaks were ascertained and given names, mostly of pioneers in the region.

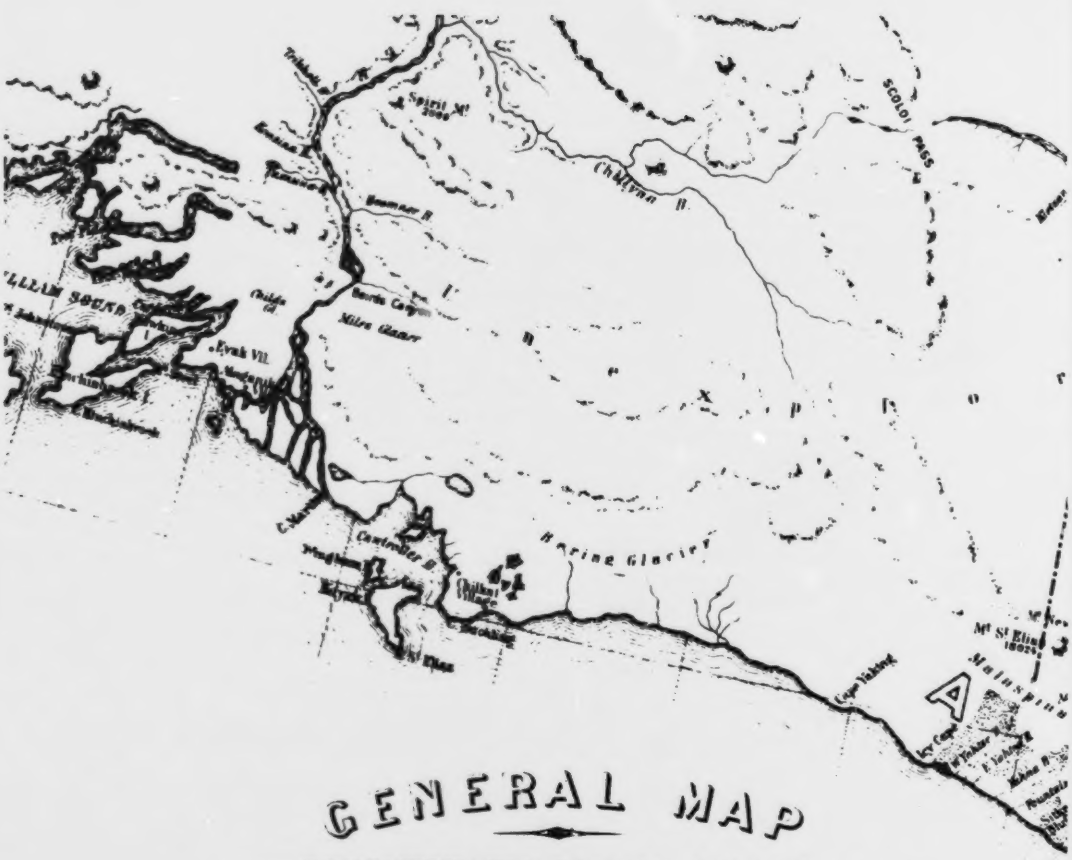
Years later the 141st meridian was carried by a joint commission of Canadian and United States surveyors from the point of intersection with the Yukon River south to Mount St. Elias, north of Icy Bay on the North Pacific. The extended line was marked by permanent monuments on hilltops and by cutting a swath through wooded areas. In a subsequent survey project the same meridian was carried north to the Arctic in like manner until it touched the ocean shore at Demarcation Point. The total distance of this meridian boundary between Alaska and the Yukon Territory is 647 miles.

In addition to his boundary survey work Ogilvie surveyed several townsites in the Yukon, including that of Fortymile camp. Gold was first discovered on Fortymile River in 1886 and about $200,000 worth of the yellow metal was taken out of the area in the following season.

In the field season of 1896 mining interest and activity in the Yukon shifted dramatically from the Fortymile River area to the Klondike River district. Among the tributaries of the Klondike were streams with names destined to become as world-famous as that of the parent waterway, creeks such as Bonanza, Gold Bottom, Hunker and Eldorado. Early in the summer of 1896 Robert Henderson, a Maritimer, along with two Swedes, Munson and Swanson and two other prospectors, came upon a creek which they judged to be a tributary of the Klondike. They found "good dirt" on panning its waters and in returning to replenish camp supplies, met a friend of Henderson's, George Washington Carmac and two Indians—Tagish Jim and Tagish Charlie—engaged in salmon-fishing at the mouth of the Klondike. In the customary manner of the Northland the fishermen were advised of the "good pay" on Gold Bottom Creek. Henderson invited his friend to join in the staking there. Later on Carmac and his Indian companions, failing to find impressive amounts of the yellow metal at Gold Bottom, crossed high ground in a trying march and reached Bonanza Creek. Here Carmac panned out $12 worth of gold within a few minutes. Further examination disclosed the presence of gold in unusually large quantities in the vicinity. Carmac staked out the 500-foot long discovery claim number one on August 17, 1896. News of the find, recorded at Fortymile a few days later, electrified settlements in the Yukon and, in time, the entire world. In fact, in some unknown manner word of the discovery circulated even before the Carmac claim was duly filed. As early as August 19 several properties were staked immediately above and below claim number one. From that moment the Klondike Gold Rush gathered momentum until it developed into the most publicized and most frenzied of all international gold stampedes.

Oddly, nearly all the most productive claims in the richest area fell to relative newcomers in the Territory. Wise old hands in Yukon prospecting were slow to join in the mad rush because, in their view, Bonanza Creek was on the "wrong side" of the Yukon River, its valley was too wide to be productive, the geological formation unpromising and its surface indications of gold far too glittering to be more than a trace!

Ogilvie, quick to sense the far-ranging implications of the discoveries, especially in the realm of general administration and law enforcement in the Territory, hastily despatched to Ottawa an informative, warning letter. The mail contractor in the region, Capt. Moore,


Spirit Mt
2000
Chilkina R.
SCOLOI PASS
Bremner R.
Childs Gl.
Miles Glacier
Eyak Vil.
SOUND
Controller B.
Bering Glacier
Chilkat
Wingham I.
Kayak I.
Mt St Elias
18023
Malaspina
Cape Yaktag
Icy Cape

GENERAL MAP
OF THE NORTHWESTERN PART OF THE
DOMINION OF CANADA

Compiled from Observations & Surveys by the Topographical Branch of the Dept of the Interior, Maps of the International Boundary Survey (Dept of the Interior); Maps of Exploratory Surveys by the Geological Survey Dept, Admiralty Charts of Polar Regions, General Chart of Alaska by U.S. Coast Survey pub. June 1891 & Official Maps of British Columbia pub. in 1895) and other authentic documents

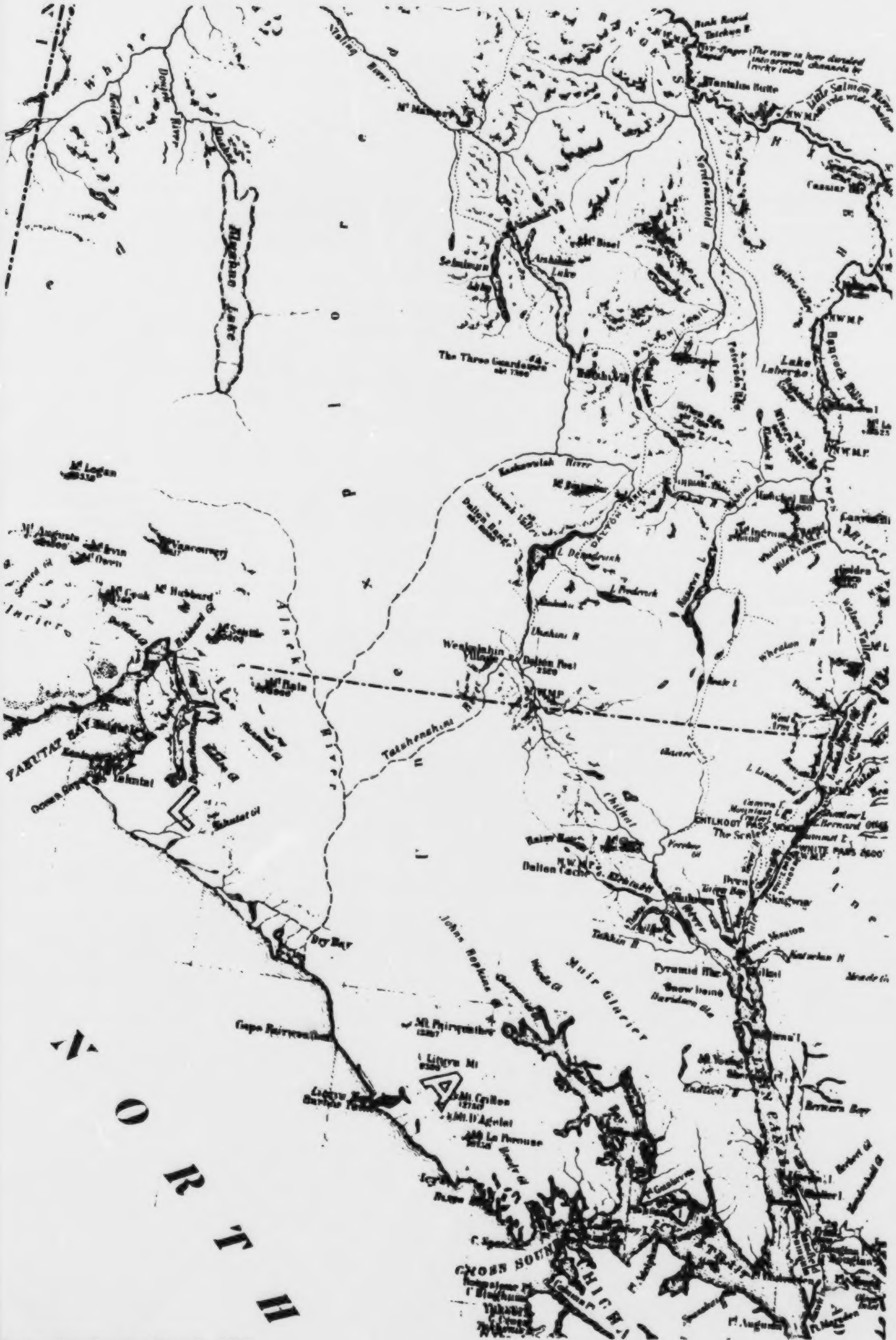
SCALE OF STATUTE MILES
10 0 10 20 30 40 50 60 70 80 90 100

Published by authority of
THE HON. CLIFFORD SIFTON, Q.C. M.P.
MINISTER OF THE INTERIOR.

December 1898

Compiled at the Surveyor General's Office
by the late J. JOHNSTON Geographer of the Interior.
completed for publication by Jacob Smith.

MAP 12. Portion of the Interior Depart


Lake Laberge
Mt Logan
Mt Augusta
Mt Cook
Mt Hubbard
Mt St Elias
YAKUTAT BAY
Yakutat
Alsek River
Tatshenshini River
Dalton Post
Dalton Cache
N.W.M.P.
Chilkat
CHILKOOT PASS
The Scales
WHITE PASS 2600'
Dyea
Skagway
Pyramid Har.
Dry Bay
Cape Fairweather
Mt Fairweather
Lituya Bay
Mt Crillon
Mt La Perouse
Muir Glacier
CROSS SOUND
N O R T H

t's map of northwestern Canada, 1898.

made a special effort to transmit Ogilvie's message to the outside in the autumn of 1896. The effort proved futile as the preliminary report won scant attention in Ottawa. In January, 1897, Ogilvie tried again to alert the authorities. He reported that the new camp promised to become the greatest ever in the Territories and of dimensions large enough to startle the world. This intelligence did not reach Ottawa until early spring when it moved sedately and obscurely through routine civil service channels.

In late September, 1897, in Vancouver, Ogilvie had a meeting with Hon. Clifford Sifton and learned that a handbook of information concerning the Klondike in particular and the Yukon in general had been prepared by a departmental clerk, partly on material submitted by Ogilvie to headquarters. Despite its secondhand authorship and pedestrian title, ***Information Respecting the Yukon District***, the publication enjoyed fairly wide circulation. Unfortunately it contained some errors due to clerical misinterpretations. When Ogilvie reached Ottawa in mid-December of that year he set about writing an official guide for those intending to join the invasion of the Yukon. But his modest journalistic effort was not off the presses until January, 1898, and by then many gold seekers had departed for the north without seeing or benefitting from it.[6]

The gold fever infected the continental United States in the spring of 1897 when two vessels, the *Excelsior* and *Portland*, arrived at Seattle from Alaska. Newspaper headlines screamed to the public that the *Portland* alone carried several score passengers who had been made fabulously rich by their gold finds in the Yukon and that there were stacks of the precious metal in the cargo holds. One reporter boldly estimated that there was more than a ton of gold aboard. This "news" created a tremendous sensation. Actually more than two tons of gold were unloaded. Excitement rose to new peaks when the *Excelsior* landed at San Francisco in the summer of that same year with a second cargo of gold. Ogilvie, who was aboard, estimated that not more than $587,000 was represented in the passenger list of the *nouveau riche*. But the press quickly miscalculated the total wealth aboard at two and a half million dollars. So great was the dockside crush of the curious and of reporters that Ogilvie, in order to escape the ordeal of interviews, passed himself off as one of the crew.[7]

In private correspondence, early in the 1897 season, Ogilvie had estimated that on Bonanza Creek alone there were then 200 very promising claims and another 80 claims on the Eldorado. As to the latter Ogilvie stated, "I can say without any fear of being found wrong that many claims on it will produce upward of one million dollars [each] . . . Bonanza, too, will show a score or two of claims verging on the million mark and many from $100,000 upwards . . . I say the Klondike Basin will this year send down $2,000,000 and next year and for several years to come more than double that figure."[8]

Indiscriminate staking of discovery claims along the Klondike and its tributaries resulted in a state of almost complete confusion over the position of property lines. Arguments raged interminably as to the size and ownership of many claims. Early in 1897 Ogilvie arrived at Dawson to lay out the townsite as well as the lines of several other blocks of land in the vicinity. A deputation of gold miners came to see the surveyor in the hope that he could somehow bring order out of their chaos. Ogilvie advised them to submit a petition signed by all miners involved in the predicament. In a few days, petitions bearing more than 130 signatures were placed in his hands.

Ogilvie, who until then had no more authority to intervene in the situation than he would be entitled to survey a town lot without its owner's consent, was now free to act. He walked over the most hotly contested ground and found a number of overlapping boundaries. Only a tiny minority of prospectors, it seemed, were familiar with the most rudimentary principles of proper claim-staking. In addition, information such as names, dates and numbers were either completely obliterated from posts or tree trunks by weathering or otherwise rendered illegible. In one area, for example, where 61 claims were staked, actual measurement revealed that the land available could, at most, contain only 52 full claims.

The first survey along Bonanza Creek was decidedly primitive in nature. A rope was obtained by the prospectors, who were led to believe that it was 50 feet long, in order to measure out properties beginning with the initial discovery claim. Ogilvie, when finally called in to sort out the resulting problems, examined under oath 13 out of the 25 prospectors who participated in that first unofficial and unbelievably crude survey. Even so he could not learn with certainty who had actually measured the rope, nor to whom it belonged and apparently nobody had seen the rope measured. Nor could he ascertain just how the rope was held in conducting the measuring process. Yet more than 50 fantastically valuable claims had been bounded in this manner in one afternoon! As a result, under Ogilvie's scientific re-survey, some exceedingly rich properties were reduced from 500 feet to 450 feet or less.[9]

One hard-bitten hold-out from the petitioning deed was a miner reputed to have threatened to shoot Ogilvie if he came near his holding to re-survey it. Ogilvie's base line ran across the belligerent fellow's cabin and Ogilvie had to set his transit on the cabin roof in order to carry the line over. This he did without hearing any remonstrance, though he knew that the miner was inside at the time. When Ogilvie descended from his precarious perch the occupant of the cabin emerged and laughingly asked him what he was doing! Then he invited Ogilvie in for a meal, an invitation gladly accepted. Ogilvie was further astonished that his host, on being advised that the survey meant that he had to move entirely off this potentially rich claim, quite willingly agreed to do so.[10]

During early 1897, up to the stage when spring thaws and resulting floods prevented active prospecting, Ogilvie surveyed 120 claims on Bonanza and 50 on Eldorado. Respected by everyone for his integrity and reliability, Ogilvie was made a sort of supreme arbiter in all property disputes in these goldfields. None of his decisions was ever seriously questioned nor was any animosity shown, no matter what the decision. The nearest policeman was 65 miles distant. It was a particularly trying experience for Ogilvie to enforce the reduction of claims when his surveys disclosed some of these to be over-size. Both firmness and diplomacy were required when every foot of the ground involved could easily contain a considerable financial return to the owner. One ten-foot-wide property on Eldorado Creek was considered to be worth between $10,000 and $20,000. A miner named Jim White managed to stake a fractional claim which, after Ogilvie's survey, turned out to be only three inches in width. Thereafter he was popularly known as "Three-Inch-White."[11]

Ogilvie remained immune from the "gold-rush" fever. He was determined not to allow any shadow of suspicion or of self-interest to diminish his good name and reputation. He did not wish to enjoy any advantage of a material nature arising from his special position or knowledge as a trusted civil servant. One pie-shaped property on Bonanza, 86 feet wide at its base, was found to be surplus to a claim according to Ogilvie's survey and thus open to anyone for staking. Later this segment proved to be one of the richest pieces of ground in the Klondike region, producing eventually half a million dollars for its owner. Although Ogilvie did stake this plot of land for himself, he relinquished it on being appointed in 1898 as Commissioner (Governor) of the Yukon Territory. This action enabled one of his survey party chainmen, Dick Lowe, to claim the slice and thus become wealthy.

Fractional claims soon acquired exceptional importance. These accidental surpluses, arising out of over-size discovery claims, were invariably marked by Ogilvie on posts at the end but not at the beginning of the fragmentary property. But the experienced, discerning prospector could detect the fractions despite this partial concealment in the interests of public peace and order. In only one historic instance did Ogilvie depart from this general pattern, a procedure by which he avoided charges of discrimination on behalf of his friends.

Clarence Berry was the half-owner of claims numbered 3, 4, 5 and 6 on Eldorado Creek. He and his partner decided to do all their preparatory, cruelly hard, winter-long work on claim number 5.

". . . I reached claim 5 in the evening", Ogilvie stated, "just as men were quitting work in the shafts below, and as it was a cold, windy day—ten below zero—I . . . directed my men to take my instruments to a nearby cabin. I then turned to my notes to figure out the length of the claim, the men, meanwhile standing around me guessing what I was doing and anxious to learn how the claim turned out in size. I never suspected a fraction here: such diligent search having been made for them in all the rich ground that it seemed impossible for one to escape [detection].

"My calculations showed that claim number 5 was 540 feet 6 inches long, thus opening a fractional claim of 41 feet 6 inches to location." This meant that all the winter's work accomplished on claim number 5 could well have been wasted. In order to prevent what could easily have developed into a wild scramble, with the possibilities of serious injuries, for the possession of the fraction by staking on the spot, Ogilvie resorted to play-acting. He was successful in diverting the attention of the onlookers by casually inviting himself to supper in Berry's cabin. In the wake of Berry's distress on hearing of the overage and the resulting probability that he would lose completely the fruits of labor, Ogilvie suggested that Berry look without delay for a friend who would agree to stake the surplus land in his own name, then transfer it to Berry in exchange for a part of the lower end of claim number 3. Berry, in record time, found a reliable friend who consented to join in this arrangement and who, in the dark of that very night, staked the fraction in strict conformity to the mining regulations as explained to him by Ogilvie. Later it was discovered that the value of the winter's dump of pay dirt, excavated by Berry and piled up on the fraction, exceeded $136,000.

Within a year of Carmac's epic discovery on Bonanza the population of Dawson had increased to 1,500 and the rush from outside the Territory had not yet made its full impact felt.* But an influx of unforeseen proportions was in the making as a result of the excitement originating in Seattle and San Francisco in the summer of 1897. By October of that year administrative problems in the burgeoning community of Dawson had become acute. Enforcement of law and order, collection of customs duties and taxes (mining royalties) and the handling of mail were suddenly transformed from leisurely, routine activities into harassing riddles. The small staff in tiny post-office premises tried valiantly to transact the postal business of a city of many thousands. One vessel's cargo included 5,700 letters. Demands for expanded public services and surveys became loud and urgent.

A growing stream of complaints reaching Ottawa drove the government to definite action. Thomas Fawcett, D.T.S., one of the men who had served under Dennis in the Surveyors' Corps in 1885, was appointed Gold Commissioner in the Yukon as well as land agent and surveyor representing the Department of the Interior in the Territory.[12] Fawcett left Ottawa for the north on May 1, 1897, accompanied by two Dominion land surveyors, James Gibbon and E. D. Bolton, along with four other men. In August it was found necessary to send reinforcements consisting of two additional Dominion land surveyors, R. W. Cautley and J. A. Cadenhead, as well as four more civil servants. In that hectic field season eight surveyors, out of a total of 29 available on the staff of the Surveyor General, were engaged in measurements in the Yukon or in related activity.

That summer Major James M. Walsh was appointed Commissioner (Governor) of the Yukon Territory. An ex-Mountie of impressive military bearing Walsh lacked the particular qualities required by the varied responsibilities of his position. Before many months had passed he tendered his resignation. Casting about for the type of man most likely to succeed in the post, the government at Ottawa approached William Ogilvie in the summer of 1898, pressing him to accept the Commissionership in succession to Walsh. He agreed and his appointment was formally confirmed on October 7, 1898. In the meantime Fawcett had been replaced as Gold Commissioner in order to assume direct supervision of general survey work in the Territory.

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*Approximately 30,000 persons were in Dawson in 1898 but the population fell swiftly after that season.

Some extracts from Fawcett's official correspondence emphasize the explosive nature of many of the problems he faced as Gold Commissioner. In a letter to Walsh early in January, 1898, Fawcett outlined some of his worries:

"I am very short-handed at the office. When the two surveyors and other assistants arrived in early October I tried my best to secure supplies to keep them here [Dawson] but failing, I got an order for supplies at Fort Yukon . . .

"The cost of surveying in this country will be so much in excess of anything in connection with which the government has had any experience in the past that I doubt that they would authorize the necessary cost of anything like an accurate survey . . . There were women rushing about and staking . . . so I set the limit [of claims] at three. It became so evident that the women were staking for speculation and not with any intention of mining, that I thought I would be justified in limiting them to a less number than the men were allowed to stake [four]."[13]

A month later Fawcett wrote to the Department of the Interior, Ottawa, in a desperate frame of mind:

"Men seem to lose all sense of honour and truth in the restless search after gold or whatever will bring it and seem to think nothing of swearing falsely . . . We have on an average two disputes per day arising mostly from jumping claims, recording claims by men who have not staked them, staking for other persons and acquiring an interest for doing so . . . ".

There was an echo, too, in his letters, of Ogilvie's experiences in the same locality in 1896:

"I want to send a survey party as early as I can have them equipped to make a survey of Dominion Creek which is in a very bad condition [of overlapping claims] through the mixing of numbers and other crooked work by those who originally staked the claims and subsequent staking of fractions. As soon as I ascertained that things were so badly entangled I closed that part of the creek and have refused to accept any more applications there until after the survey. There are a good many cases of frozen feet and faces . . . A . . . Mr. Hamlin, D.L.S., [probably L. B. Hamlin] . . . who had been on Sulphur Creek . . . had been very badly frozen . . . It seems he was sent out by the Provincial Government [B.C.] to examine and report on the Hootalinquia route and he came on here instead of going back to Victoria."[14]

In mid-April Fawcett advised Surveyor General Deville of survey activities then under way:

"My entire survey staff is employed at present laying out all the available ground to enlarge the townsite of Dawson. I expect the land which is now being laid out into lots will, when sold, realize not less than $30,000 . . .

"I will have to send my party over to Dominion [Creek] in a few days to survey the portion which I closed last November because of the overlapping of claims . . . I will have a member of the Mounted Police accompany the survey party to eject those who have taken possession after the ground was closed and not open for further location."[15]

Grievances were still rampant among the miners at Dawson at the time of Commissioner Walsh's departure from office. Discontent reached its peak at a meeting of prospectors there in the summer of 1898. A petition was drawn up as a result and mailed to Prime Minister

Sir Wilfrid Laurier on August 15. In this document it was alleged that "many government officials have forfeited claim to people's confidence and respect". The administration of the Gold Commissioner's office also came under fire and it was hinted that information about unrecorded ground had been improperly conveyed to individuals outside that office. The words "incompetence", "breaches of trust" and "malfeasance of office" were employed as well as complaints about "the want of experience of mining inspectors."

In this charged and uninviting atmosphere Commissioner Ogilvie assumed his new duties. His appointment, however, met with undisguised satisfaction not only among responsible elements in the Territory but also in the ranks of American adventurers who, by then, formed the vast majority of the Yukon's population. Many of these newcomers were highly individualistic personalities who were not by nature readily amenable to civil authority. But they had heard from Yukon old-timers of Ogilvie's characteristic indifference to personal advantage, of his deep understanding of the prospector's mentality as well as of his firmness and fairness in dispensing justice "without favor or affection". So it came about that the man who had done his utmost in 1896 to alert Ottawa to impending troubles in the goldfields of the north was drafted to repair the damage resulting in the interval from official ignorance and neglect.

Ogilvie's initiation to the duties of his high post was made easier by a timely announcement from Ottawa that a Royal Commission would be set up to hear grievances and to inquire into the charges of graft by various officials. Through the mid-winter months (1898-99) at Dawson the new Commissioner presided at sessions of the public investigation. The results were inconclusive but the hearings served the useful purpose of providing a safety valve for the releasing of pent-up resentments and feelings of hostility toward officialdom. Ogilvie, in his report to Ottawa, reduced the charges to their original trivial proportions. Confidence in administrative integrity was speedily restored. Although the departmental foundations of Territorial government had been established under Commissioner Walsh, much remained to be done, following his brief tenure of office, to enable public services to function efficiently. In this respect Ogilvie accomplished miracles under most difficult circumstances. Able men were drafted into the civil service. Voluminous correspondence was handled punctually and effectively. New mining regulations were devised to meet special situations. Courts and schools were established and strengthened. Above all, law and order were fully restored.[16]

Ogilvie remained in office until 1901 when he decided that his work as Commissioner was completed. His term had been distinguished by a visit to the Territory in the summer of 1900 by the Governor General of Canada, Lord Minto, accompanied by Lady Minto. The Governor General, in a letter to Ogilvie, complimented him on the "excellent arrangements made for our reception" and His Excellency forwarded to the Commissioner a gift of vice-regal photographs. He invited Ogilvie to come to Rideau Hall when next he visited Ottawa.[17]

The Legislative Council of the Yukon Territory lamented over the departure of Ogilvie from the Commissionership and presented him with the text of a unanimous resolution in which they sadly took "this last opportunity of expressing . . . the high appreciation of his conduct in all his dealings with the Council and . . . his continuous efforts to help in the development and welfare of this Territory under the most trying difficulties due to the peculiar circumstances under which the Territory was opened."[18]

Ogilvie's accomplishments as Commissioner were made possible in great measure because of his exemplary conduct, judicial temperament and highly practical contributions to the advancement of the Yukon over a period of years immediately preceding his elevation to the governorship. His ability to adjust bitter disputes peacefully and thus avoid possible serious complications was everywhere realized. Deputy Minister of the Interior James A.

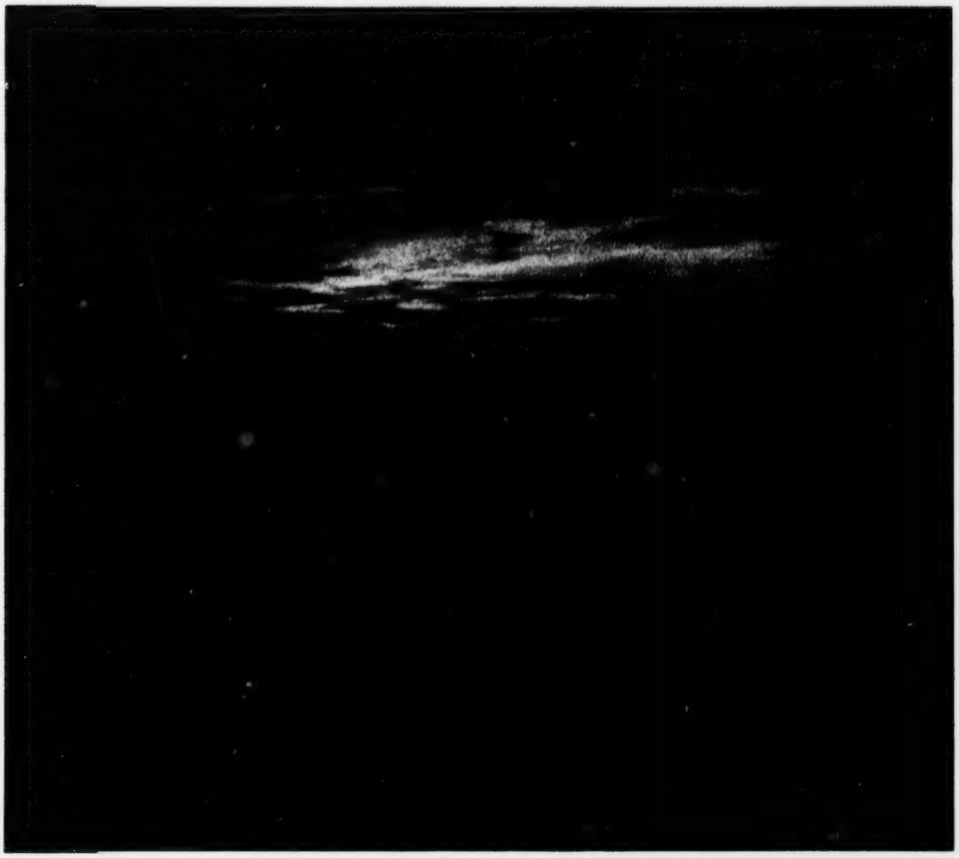

FIGURE 70. Sunset on the Klondike, the river that gave its name to the famous Yukon goldfield. Between 1897 and 1904 more than $100,000,000 worth of gold was produced in this area.

Smart paid Ogilvie a well-merited tribute in a public statement applauding his services to Canada:

"I consider it my duty to place on record . . . the Department's high appreciation of the very able and satisfactory manner in which Mr. Ogilvie has discharged the important and delicate duties entrusted to him by the Government of Canada in connection with the development of this district. The marked ability and tact which he has displayed at all times throughout his arduous operations, and his constant endeavour, under most trying circumstances, to properly safeguard the interests of the Government of his country, justly entitle him to the esteem and gratitude of the Canadian people."[19]

Interior Minister Sifton, too, had occasion to refer to Ogilvie as "a man of highest character and attainments".[20] On June 30, 1898, Sifton wrote to Ogilvie, enclosing a cheque for $5,000, the amount voted by Parliament "in recognition of your services in the various explorations you have made in the Western and North Western portions of Canada". This, however, was not the first time that these same achievements had won noteworthy attention and appreciation. In 1891 Ogilvie had been awarded the much-coveted Murchison Grant, an award fathered by Sir R. I. Murchison, a former president of the Royal Geographical Society.

With the advent of modern methods of mining gold much of the romance associated with prospecting on the northern creeks disappeared from the Yukon scene. Large corporations, extensively financed and equipped with giant dredges, entered the field and engaged in intensive re-working of Klondike hills, valleys and streams from which so much wealth had already been extracted, with so much hardship and drudgery, by individual miners. The use of panning and primitive sluices was replaced by electrically-driven heavy machinery, operating night and day during the open season.

Ogilvie resumed his private surveying practice in eastern Canada following his departure from the Yukon. In 1911 he returned to the western interior under the authority of the Railway Branch of the Department of the Interior. He had been asked to report on the suitability of land for reclamation in The Pas district. This assignment proved to be one of his last important survey undertakings. While in the vicinity of James Bay he contracted pneumonia and, at the age of 66, died in the Winnipeg General Hospital in November, 1912. The funeral service was held in his Ottawa home and his remains were interred in Beechwood cemetery in the capital city of his beloved country.

The Ogilvie Range of mountains in the Yukon, Mount Ogilvie on the boundary of British Columbia and Alaska as well as a wide Yukon valley and a Manitoba hamlet today bear the name of this distinguished surveyor and attest to the high character and attainments of an eminent Canadian.

10

RENEWED INTERNATIONAL BOUNDARY-LINE SURVEYS

> *"I am near to the place where they should meet, if Pisanio . . . mapped it truly."*
>
> Cymbeline, Act 4, Sc. 1

The heroic deeds of explorer-surveyors, men of the calibre of Champlain, Mackenzie, Thompson and Fraser, are the stuff of legend and rightfully enjoy prominence in the story of Canada's development. But the work of pioneer land, railway and boundary surveyors, which helped to transform a vast wilderness into ordered growth, has seldom stirred public imagination. Yet these men, too, subdued the unknown and replaced ignorance with knowledge. The lives of frontier scouts, of cowboys, soldiers and mounties have become invested with a glamor not bestowed upon surveyors working by celestial and terrestrial rules applied through the expert use of their modest, unspectacular instruments. The bold advances of the Wolseley expedition of 1870 and of Canadian mounted police in their famous trek from Dufferin to Fort Macleod in 1874 have become part of Canadian folklore. Yet, whether in treacherous muskeg west of the Lake of the Woods or on the seemingly limitless plains in the vicinity of Red River or hundreds of miles to the west of that waterway, men in uniform found that dauntless surveyors had been there before them. It was, in fact, at the Wood Mountain survey depot, 430 miles west of Red River and 22 miles north of the 49th parallel of latitude, a provisioning point of the international boundary-marking project, that Commissioner Macleod and his weary mounties obtained essential supplies that enabled them to continue their journey to the foothills of the Rockies. By that time the boundary surveyors had nearly completed their allotted task. Perhaps if their relatively mundane mission had been less well-performed or less practical in its uses, their accomplishments might have been gloriously enshrined in the national story as an exciting, epic chapter of achievement.

The success of Canadian and United States boundary survey commissions from 1857 to 1862 in cooperatively establishing the land line separating the two countries in the Pacific Northwest had amply demonstrated the effectiveness of this type of joint action. Cordial and efficient teamwork in this somewhat sensitive area helped greatly to dispel feelings of ill-will generated in both countries by angry differences over the location of the boundary separating islands in the Strait of Georgia.

Archibald Campbell (1813-1887), Chief Clerk in the War Department, Washington, was the United States Commissioner of these surveys. Lieut.-Col. John S. Hawkins, R.E., was chief British representative for the establishment of this land boundary. "It is possible", Hawkins read in his general instructions from London, "that you will hereafter be required to continue the survey from that point [crest of the Rockies] to the Lake of the Woods. Her Majesty's Government have made a proposal to that effect to the Government of the United States, but whether the proposal is accepted or not, you will have in all probability sufficient work to occupy you for two seasons in surveying the Boundary under the Treaty of 1846."[1]

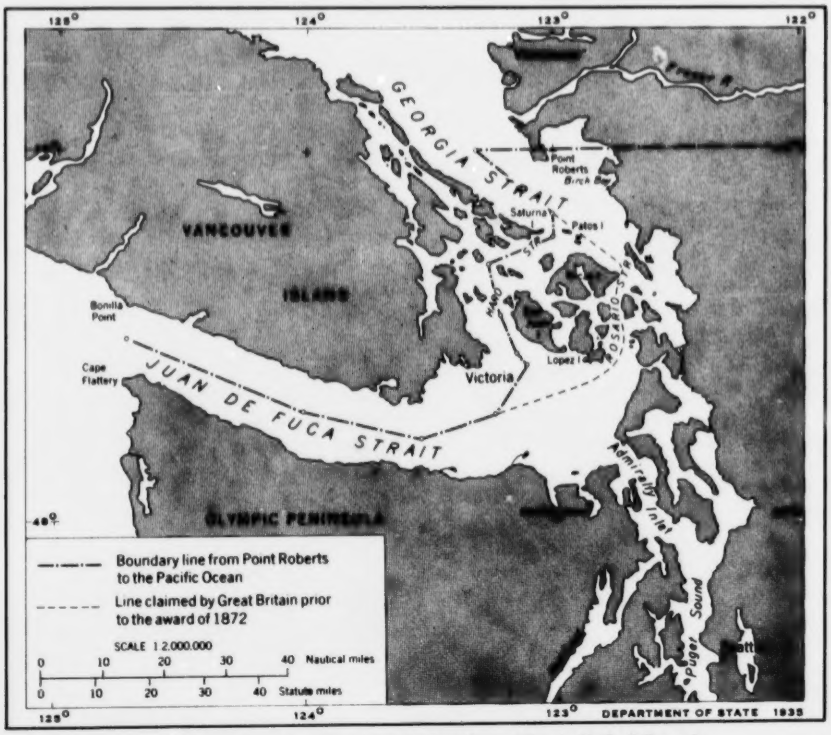
125°
124°
123°
122°
Fraser R.
GEORGIA STRAIT
Point Roberts
Birch Bay
Saturna
Patos I
HARO STR
ROSARIO STR
VANCOUVER
ISLAND
Bonilla Point
Cape Flattery
Victoria
Lopez I
JUAN DE FUCA STRAIT
Admiralty Inlet
Puget Sound
OLYMPIC PENINSULA
48°
Boundary line from Point Roberts to the Pacific Ocean
Line claimed by Great Britain prior to the award of 1872
SCALE 1:2,000,000
0 10 20 30 40 Nautical miles
0 10 20 30 40 Statute miles
125°
124°
123°
DEPARTMENT OF STATE 1935

FIGURE 71. Boundary claims and settlement line in Gulf of Georgia.

In addition to his chief astronomer, Capt. R. W. Haig, R.A., Hawkins had assisting him three officers of the Royal Engineers, namely, Capt. C. J. Darrah and Lieuts. Charles W. Wilson and Samuel Anderson. Just prior to the submission of the final report of the British Commission, Anderson replaced Wilson as secretary to the British side. As a result of the work of both commissions, twenty-eight astronomic stations were established along the border across a distance of 409 miles. Intervening points were established by straight lines (tangents) drawn between the basic stations, and monumented. Vistas or swaths were cut through timber stands between marked points except in high, rugged, mountainous sections. Timber-cutting was completed across a total distance of 90 miles. In all, 161 monuments were erected.

The Americans completed their field work west of the Rockies in the 1861 season. The British side finished their assignment in the spring of 1862. The compiling of maps and completion of reports occupied several years. The preoccupation of Washington officialdom with crises of the American Civil War resulted in a postponement of the final settlement and it was not until 1869 that Col. Hawkins, in company with Lieut. Samuel Anderson, went to Washington to sign the final maps and documents relating to the land boundary in the Pacific Northwest, stretching from Point Roberts to the crest of the Rocky Mountains, along the 49th parallel. Both sides reserved for future decision the "middle channel" dispute over the water boundary, an argument that was to be decided against Canada by the arbitrator. The survey on the mainland cost the United States $600,000 and the British nearly £110,000.

The experience gained by Lieut. Anderson turned out to be an invaluable asset for the British and Canadian side in future boundary surveys involving the United States. The close relationship between Anderson and Wilson, whom he had replaced in this type of survey work, was to prove useful also in this highly specialized field. In time Wilson, after a period of service as Capt. Wilson in charge of the topographical department of the War Office in London, became Major General Sir Charles W. Wilson following the Nile Expedition formed to relieve General "Chinese" Gordon at Khartoum. Toward the end of that historic episode, Wilson commanded the advance column of the expedition. This 1884-85 venture was the first major overseas military operation conducted by the British in which Canadians, serving in a contingent of voyageurs, participated as citizens of a self-governing part of the British Empire.[2] From 1886 to 1893 Wilson was Director General of the Ordnance Survey of the United Kingdom.

Barely a year had elapsed following the final formal agreement on the boundary in the Pacific Northwest when President U. S. Grant sent a message to Congress proposing a joint United States-British project to mark the boundary between the Lake of the Woods and the summit of the Rocky Mountains. Indicative of the general vagueness of American knowledge concerning Canadian geography, the President confused the Strait of Georgia with Georgian Bay in his message of December 5, 1870.

"The land boundary", President Grant stated, "has already been fixed and marked from the summit of the Rocky Mountains to the Georgian Bay. It should now be in like manner marked from the Lake of the Woods to the summit of the Rocky Mountains." Moreover, the same error is repeated in a formal statement to the President from his Secretary of State, Hon. Hamilton Fish, seven years later.[3]

With arbitration of the San Juan Island dispute under way, official attention had turned from the Pacific Northwest to a comprehensive survey of the Canada-United States land boundary between the Lake of the Woods and the Rockies. Fenian raids into Manitoba from the south in 1871, as well as continuing uncertainty over the precise location of the border at the western extremity of the Lake of the Woods and at Pembina, south of Winnipeg, served to expedite survey preparations. In March, 1872, Congress voted $50,000 so that operations could commence. The British and Canadian governments each agreed to pay half the costs of the British Commission.[4] Prime Minister Macdonald submitted to London a nomination for the post of British Commissioner of the boundary survey. He recommended, not a Canadian, but a Scottish-born officer of the Royal Artillery, Capt. Donald Roderick Cameron (1834-1921). In the course of his service career Cameron was posted to Halifax where, in 1869, he married the daughter of a Nova Scotian destined to become Prime Minister of Canada, namely, Dr. Charles Tupper. In the following year Tupper entered the Dominion cabinet as President of the Council. The newly-married Cameron was assigned as an aide, by Sir John A. Macdonald, to the staff of Hon. William

McDougall, then Lieutenant-Governor designate of the North-West Territory. His relations with McDougall had not been particularly congenial during the ill-starred, futile expedition of the autumn and winter of 1869. Cameron became friendly, however, with Bishop Taché of St. Boniface and the Scot made use of his training in French military schools by translating into English the bishop's *Sketch of the North-West of America.*

Three years after the fiasco at Pembina, Cameron was once more in the public limelight. The War Office in London, though unenthused over the Macdonald nomination, appointed Cameron to the post of British Commissioner (Hawkins being unavailable) but assigned Lieut. Samuel Anderson to the expedition as chief astronomer, with Lieut. Albany Featherstonhaugh as his first-ranking assistant. Both Anderson and Featherstonhaugh were promoted to captaincies in August, 1872. Cameron's choice for secretary of the British Commission was Lieut. Arthur C. Ward, R.E. Ward had known Cameron in Nova Scotia previous to the latter's marriage there. Another officer of the Royal Engineers, Lieut. William J. Galwey, was named as assistant astronomer. Forty-five non-commissioned officers and men of the Royal Engineers were selected by Anderson to form part of the expedition. In his ability to assume leadership of field parties, Sergeant Kay proved to be the most notable of these well-trained, disciplined and resourceful men.

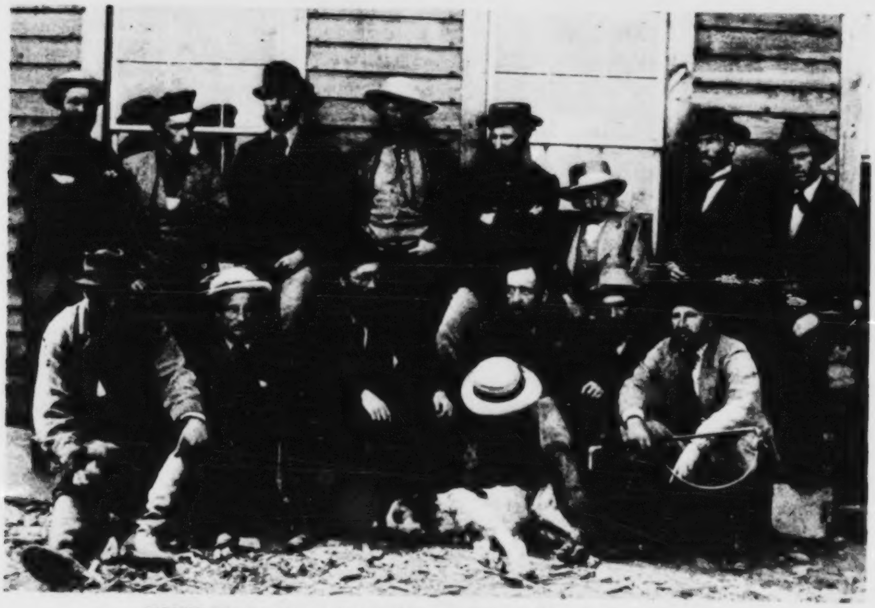

FIGURE 72. Her Majesty's Boundary Commission (49th Parallel) 1872-76.

In addition to British members of the expedition, Cameron placed Canadian civilian personnel on the Commission staff, namely, W. F. King, W. A. Ashe, G. F. Burpee, G. C. Coster, L. W. Herchmer, Dr. T. J. W. Burgess, Dr. Thomas Millman, Dr. W. G. Boswell and Dr. G. M. Dawson. The principal survey positions on the Canadian side of the affair were filled by Lieut.-Col. A. G. Forrest of the Canadian Militia, Ottawa, and Alexander Lord Russell (1842-1922). Both Forrest and Russell were Provincial Land Surveyors, Ontario.* Major Macdonald, an experienced Canadian militia officer, helped organize the expedition in its early stages.

On the American Commission the influence of West Point was predominant, just as traditions of the Royal Engineers weighed heavily on the British side of the boundary-marking project. The United States Commissioner, Archibald Campbell, was a veteran of railway, canal and boundary surveys, and a West Point graduate, as were two of his three assistant astronomers, Capt. J. F. Gregory and Lieut. F. W. Greene. The third assistant named at the time of the formation of the commission was Brevet** Major William J. Twining, a lecturer at West Point. Brevet Lieut.-Col. Francis U. Farquhar was named chief astronomer. Dr. Elliott Coues joined the United States Commission as its medical officer and naturalist. James E. Bangs functioned as its secretary.

In rates of field remuneration the military personnel of the British Commission fared considerably better than their American counterparts because of the provision of "boundary pay" additional to their regular army pay. They received advances of £100 each for equipment, in addition to travel expenses and rations. The Americans admitted that the quality of the British survey instruments was superior to that of their own. Canadians on the staff of the British Commission ranked as officers and received the same allowances for outfitting as the Royal Engineers. The surveyors among them received $1,800 a year and assistant astronomers King, Ashe, Burpee and Coster received $1,500 a year.

Payment of laborers on the survey proved to be a problem during early stages of the project. "The rates of wages in Manitoba", reported Cameron, "were so very much higher than those which prevailed in farming districts of Eastern Canada and the States, that it became necessary to bring in competition from these quarters. By this means the lowest rate was reduced from 1 dollar, 50 cents to 1 dollar, the former being that which was prevalent in Manitoba and at which men were hired by the Dominion Government at Ottawa on the parties being first organized."[5]

Considerable foresight was shown by the Royal Engineers, based upon their experience in British Columbia a decade earlier, in assembling for this venture into the western interior of North America a library of varied reading for the information and entertainment of members of the field party during off-duty periods. Fiction, history, plays, poetry and essays by British and American authors were included in this portable library. During prolonged spring thaws especially, when active surveying was impossible, this collection of books proved most beneficial. At the conclusion of the boundary-marking project the library was sold.

Cameron was meticulous in his paper work and in the organization of his men. He was strong on discipline but his relative ignorance of theoretical and practical aspects of surveying was the despair of his British colleagues. His relations with Campbell, following a brief initial period of harmonious cooperation, were less than cordial. But his failure to agree promptly with the American viewpoint on all questions may have been due as much to the limitation of his instructions from the Foreign Office in London as to any temperamental deficiency on his part. Cameron divided functions of the British Commission into seven categories and named the following as chiefs:

Topography : Lieut. Anderson
Commissariat : Mr. Herchmer
Medical : Dr. Burgess, assisted by Dr. Millman

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*In regard to this appointment A. L. Russell is sometimes confused with L. A. Russell, then the Assistant Surveyor General of Canada. The latter's connection with this boundary survey was confined to his telegraphic signals from Chicago in 1872.

**Brevet denotes a commission that gives an officer a title above his rate of pay.

Veterinary : Dr. Boswell
Natural History : Dr. Dawson

Cameron, it is assumed, headed the other two categories, Intelligence and Headquarters. The fact that Canadians were allotted important duties on this project was, in itself, an eloquent indication of Ottawa's growing insistence that Canadians must exercise more than an indirect influence on decisions and findings of international bodies vitally affecting the national interests of the Dominion.

The scientific reputation of 25-year old George Mercer Dawson (1849-1901), son of Sir William Dawson, principal of McGill University, was firmly established by his noteworthy 387-page *Report on the Geology and Resources of the Region in the Vicinity of the 49th Parallel from the Lake of the Woods to the Rocky Mountains*. Shortly after its publication Dawson was appointed Chief Geologist of the Geological Survey of Canada. He became Assistant Director of the organization in 1883 and its Director 12 years later. In 1888 he was asked to go to Washington, D.C. to confer on the Canada-Alaska boundary question. For his work on the Bering Sea Commission in the early 1890s Dawson was made a Companion of St. Michael and St. George. "Doctor George", as he was familiarly known, became one of the most outstanding scientists Canada has ever produced. He helped to build reliable foundations for much of the geological and botanical knowledge that Canadians possess concerning the western and northwestern regions of their country. It was mainly his pioneer work along the 49th parallel that established his reputation as a profound scholar and skilled observer.

W. F. King, fresh out of the University of Toronto and filled with the eager enthusiasm of an 18-year old on the brink of a fascinating adventure, wrote to his father from Pembina late in September, 1872:

"Today is Thursday, just two weeks since I started—meeting on the train Dr. Burgess, Captain Anderson, Captain Featherstonhaugh, Lieut. Galway [sic] and Major Macdonald . . ." Young King then related how he had journeyed to Thunder Bay by way of Collingwood, across Lake Huron to Little Current, St. Mary's Village to Thunder Bay. Crossing to Duluth he travelled by the Northern Pacific to Moorhead, Minnesota. "We went aboard the *Selkirk*, a flat-bottomed steamboat with a stern wheel. On Wednesday we arrived here at the Hudson Bay Post at Pembina, Manitoba . . . I shall describe the voyage on the Red River some other time. We are encamped a little way from the Hudson Bay Post and about half a mile from the Yankee camp and 2½ miles from the American Village at Pembina. You had better address your reply to W. F. King, care of Captain Cameron, N.A.B.C., Pembina, until I send you further notice [6 cent stamp] . . . ".[6]

In approaching their survey task the boundary commissioners faced an assortment of treaties dealing with the legal and political aspects of the boundary from the Lake of the Woods to the summit of the Rockies. Article 7 of the Treaty of Ghent had authorized commissioners to determine, in accordance with the 1783 treaty, that part of the boundary extending from the water communications between Lake Huron and Lake Superior "to the most North Western point of the Lake of the Woods" and to cause such parts of the said boundary to be surveyed and marked. Particular attention was to be given to the location by latitude and longitude readings of "the most North Western point".*

As late as 1818, when the Boundary Convention was concluded between Great Britain and the United States, it was obvious that the location of the most northwestern point in the

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*Allusions to the North Western Point began to replace references to North West Angle in treaty terminology in the early 19th century. The Angle is now generally regarded as the arm of the Lake in which the most northwestern point was originally located.

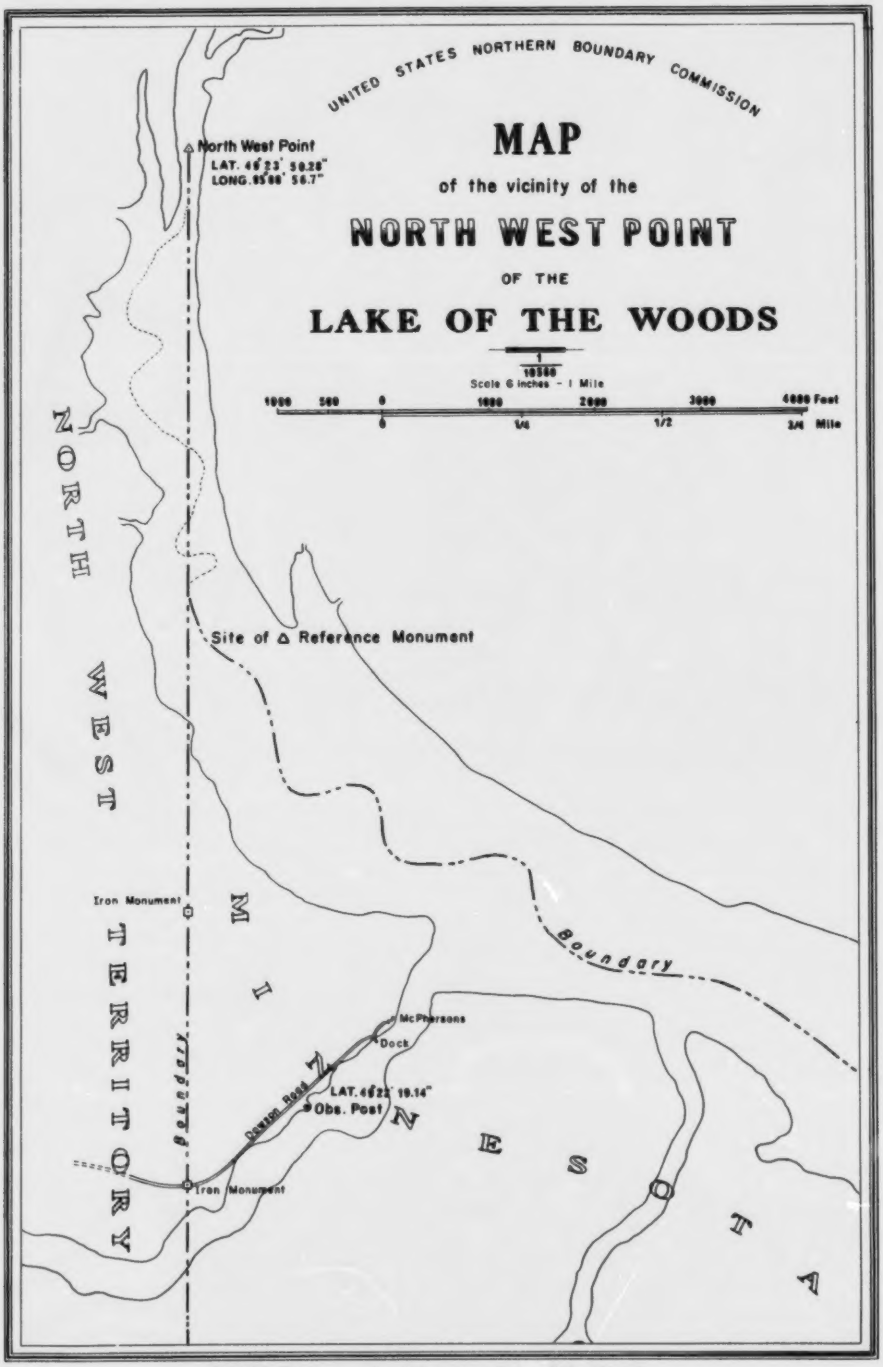
UNITED STATES NORTHERN BOUNDARY COMMISSION
MAP
of the vicinity of the
NORTH WEST POINT
OF THE
LAKE OF THE WOODS
1/10560
Scale 6 inches - 1 Mile
1000 500 0 1000 2000 3000 4000 Feet
0 1/4 1/2 3/4 Mile
North West Point
LAT. 49°23' 50.28"
LONG. 95°08' 56.7"
Site of Reference Monument
NORTH WEST TERRITORY
MINNESOTA
Boundary
Iron Monument
McPhersons
Dock
Dawson Road
LAT. 49°22' 19.14"
Obs. Post
Iron Monument
Boundary

FIGURE 73. International Boundary, Lake of the Woods.

Lake of the Woods was not definitely known to those who framed and signed its provisions. By Article 2 of that convention it was agreed by the two contracting powers that a line from that point along the 49th parallel, "or a line drawn due north or south as the Case may be" until that line intersected the 49th parallel and from the intersection due west along that parallel "shall be the Southern Boundary" of the territories of Great Britain *from the Lake of the Woods to Stony Mountains.* (author's italics)

Between the conclusion of the 1818 Convention and the signing of the Webster-Ashburton Treaty of 1842 the name "Stony Mountains" was replaced, in popular and official parlance, by the term "Rocky Mountains". By the 1842 treaty the boundary was redefined as between these two geographical features. The latitude and longitude of the most northwestern point had been determined by special surveys made by David Thompson and Dr. Tiarks in 1824-25. The coordinates as ascertained by Tiarks were mentioned in the text of the Webster-Ashburton Treaty as 49° 23′ 55″ north latitude and 95° 14′ 38″ west longitude. Because the point was not located on firm ground it could not be marked in the customary manner. But a reference monument had been erected by Thompson in the form of a pyramid of logs of oak and aspen.

In July, 1872, in Washington, D.C., the two boundary commissioners met each other for the first time. They agreed quickly upon a three-pronged initial assault on the task assigned to them. First, they would ascertain with accuracy a point on the 49th parallel close to the western bank of the Red River. Once that point was determined the second step would be taken, that of surveying the boundary line to the east during what remained of the 1872 field season. Thirdly, portions of the eastward-trending line that were wooded were to be cleared to a width of 30 feet by the British party at the joint expense of the two nations.

It was September before the two commissioners arrived at the point of beginning of the boundary survey. The Americans encamped at Pembina and the British-Canadian party occupied specially-constructed barracks at Dufferin, as North Pembina (Canada) had come to be called. Early in October the British and American chief astronomers arrived at the Lake of the Woods. The North West Angle of the lake was located without difficulty but several days of careful search was required, along with assistance of local Indians, to discover the remains of the David Thompson reference monument of 1824. This consisted of a partial crib of hand-hewn logs, submerged in several feet of water. When measurements were made by Farquhar and Anderson from the site of the crib remains, it was found that the most northwestern point lay close to the limit of the North West Arm and within 500 feet of the latitude fixed by Tiarks almost half a century earlier.

Cameron and Campbell arrived on the scene a fortnight later and the easy cordiality that had featured their relationship up until that time, ended abruptly. Campbell was fully prepared to accept the recovered monument as conclusive evidence of the location of the key boundary point. Cameron, however, mindful of his instructions from London to avoid premature discussions in the matter, could not be induced to make the finding unanimous. Campbell and his American associates, as well as Anderson, were much aggravated by the stubborn attitude of the British Commissioner, although they must have realized that his decision to leave the issue unsettled had been taken in the hope that the two major governments could somehow reach a mutually satisfactory arrangement. Twining, who succeeded Farquhar as chief United States astronomer early in 1873, dealt understandingly with Cameron's viewpoint when he made his final report:

"...considering that the northwest point, so determined", Twining wrote, "lies within what must be acknowledged to be English territory, I am of the opinion that the English commissioner may, without being considered as acting in an obstructive manner, take the ground that the evidence is not conclusive but in making such objection, it is incumbent on him to suggest some other point as the "most northwestern" which the shape of the bay would render possible".[7]

Cameron, of course, did not act upon what seemed to be a reasonable American suggestion. But before long he found that two could play at his waiting game. When Cameron, following the return of the commissioners to Red River early in November, hastily tried to obtain official confirmation of the exact location of the 49th parallel on that river, he was met with the explanation that American astronomical calculations had not been completed. Autumn coolness was in the prairie air in more ways than one. But Cameron had not been completely uncooperative. He willingly agreed to the cutting of a sight line due south from the point in the North West Arm recommended by the two chief astronomers and Campbell. This agreement involved the clearing of a 16-mile swath through the wooded peninsula to its south shore.

By November the Americans had nearly exhausted the funds at their disposal and were compelled to withdraw from field work and to confine their activities to paper work in a headquarters office in Detroit for the winter season. This financial plight was relieved when Congress in its winter session voted $125,000 for a continuation of the boundary survey.

Travel conditions in the early winter of 1872 on this section of boundary survey work are graphically outlined by Capt. J. F. Gregory in his final report to the Chief (U.S.) Astronomer:

"I reached Fort Pembina with the animals [from Point de Chêne] in a much exhausted condition, owing to scanty forage and the very bad condition of the roads. On one day, the 5th [of November], because of the almost bottomless mud, we made but 11 miles, although the wagons were light and we were on the road from daylight until three hours after dark". Departing from Pembina on November 12, Gregory reports: "On the second day out we were overtaken by a very severe snowstorm of two days' duration, which was succeeded by bitter cold winds, with the thermometer much of the time below zero—and as the men were not provided with suitable winter clothing, they experienced much discomfort, though none were seriously frozen."[8]

In the last week of November, 1872, Anderson returned to Fort Garry on completing his observations at the Lake of the Woods. Over the newly-installed telegraph facilities he received a message urging him to go without delay to Dufferin and from the Red River station there to enter into an exchange of telegraphic signals with Lindsay Russell, Assistant Surveyor General of Canada. Russell, with the generous assistance of Professor Stafford, Director of the Chicago Observatory, had been successful in arranging for the use of lines between the two stations for one hour on each of five nights during the winter season. Russell's story of this momentous enterprise is contained in cold, official terms:

"For the purposes of the International Boundary Commission and those of the Dominion Land Survey, in 1872 Captain Anderson, R.E., Chief Astronomer of the British Commission at Pembina, in cooperation with myself at Chicago, determined by electro-telegraphic method the difference in longitude between the Observatory at Chicago, and his astronomic station at the former place. This, with the known reliable position of Chicago and Greenwich, will give by reference to the Pembina station the necessary connection of all our future surveys with Greenwich."[9] This interchange of time signals indicated that the Red River station was at 97° 13′ 51″ west longitude. From this point longitudes east and west were determined by measurements along the boundary.

Twining and Featherstonhaugh conducted a series of observations in the boundary area at Red River in order to determine latitude with precision. Their conclusions, calculated separately, differed by only 32 feet. This difference was halved in order to reach a fix agreeable to both commissions. These findings confirmed the location of the Hudson's Bay Company store as north of the 49th parallel by about 100 yards. Canada's custom house, however, was found to be more than 500 feet inside the United States.

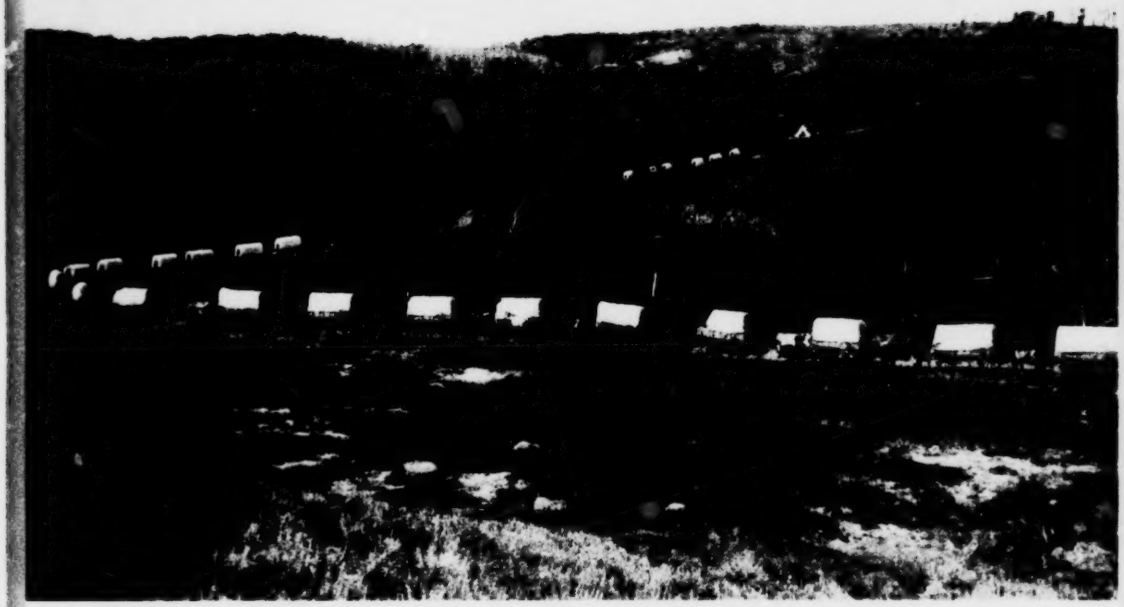

FIGURE 74. British survey party supply train, 49th Parallel.

The opening of the 1873 field season, marking the beginning of the long trek westward of both the British and American boundary parties, revealed an interesting contrast in national policies concerning the provision of military protection for surveyors and supporting elements. As a precaution against possible active Indian hostility the Americans were accompanied by two companies of regular cavalry and a company of infantry, the whole force totalling about 230 men. On the other hand the British did not consider an armed escort necessary to the safety of their survey party. A show of the flag, in Cameron's view, was sufficient immunity from Indian attacks. His attitude proved to be a trifle optimistic. Several incidents of harassment of his surveyors by the Sioux, raids unmentioned in British records, were reported by American observers. Generally, however, tribes of the western interior seemed well-disposed to the white intruders.

Nevertheless the British made one concession to caution when Cameron hired William Hallett, a veteran hunter of the plains, to recruit and command a troop of 30 armed, mounted métis, to function as guides, hunters and cattle herders. As a pleasant gesture to the boundary assignment on which they served, these riders were jocularly known as the "49th Rangers". Instructions from the Foreign Office that a special survey be made of the Lake of the Woods provided Anderson with an opening to request additional men. Reinforcements arrived in the spring in the persons of Lieut. Valentine F. Rowe, R.E., and George C. Crompton, a former officer of the Royal Navy. D'Arcy East, formerly an officer with the Royal Artillery, also arrived to take the place of Hallett, who had died in the winter of 1872-73.

On May 12 the first party of surveyors to enter the field in the 1873 season was a British group under the command of Sergeant Kay. They commenced mapping a 6-mile-wide belt north of the 49th parallel and westward to the Pembina River. There the party linked up with A. L. Russell's party operating in the territory adjoining to the west. On May 26 Lieut. Galwey took the first astronomical party of the season into the field. On June 7 Capt. Featherstonhaugh led his party to the east side of Pembina Mountain, about 35 miles west of Dufferin. These stations were observed by the experts of both commissions and in view of the negligible differences in their respective findings the two chief astronomers agreed that the British and Americans could observe at alternate stations to avoid duplication of effort and to save time.

Daytime temperatures often rose to very high levels; nights on the prairies were usually cool and would have been entirely refreshing but for the traditional affliction of North American land surveyors. At dusk mosquitoes attacked men and beasts in ravenous hordes. The tender skin rimming the eyes of transport animals attracted swarms of the tormenting insects. Bulldog flies, whose bites left bubbles of blood on humans and animals alike, proved to be an added ordeal. Horses, in particular, suffered greatly and had to be tied to prevent their escape into the night.

Surveyors and their wagon trains formed an imposing cavalcade as they travelled across the empty, dusty plains. For the most part oxen were used by the British for hauling heavy commissariat transport; the Americans favored the use of mules. Cameron, in his report, gives an interesting, detailed description of the utilitarian, two-wheeled Red River carts:

"They are made entirely of wood, unless friction plates of iron are specially ordered for the axle-tree arms and metal bouches for the naves. The shafts and transoms forming the frame are of oak; and the guard-rails of strips of oak, supported by ashen or oak rods inserted in the framework . . . Two spare axles were carried with every cart, and a few spare wheels were supplied, but these precautions were quite insufficient. The breakages were repaired, but in very numerous instances the wrecked vehicles had to be abandoned on treeless wastes. The shafts and bodies of these carts, however, proved thoroughly substancial [sic]; and when mounted on spare . . . wheels and axles they answered every purpose that could be desired, and made most economical vehicles."[10]

While British astronomers observed the stars to fix the position on the ground of each astronomic station, assistants would survey a tangent (straight line) to the next station to connect up with it—a line laid down at right angles to the meridian of the previous stations and continued by chain and transit work to the meridian of the next following station. Then right-angle offsets from the tangent to the parallel were measured out on the ground at from one- to three-mile intervals. At these points permanent marks were erected along the boundary. One-mile intervals were adopted as far as the west boundary of Manitoba, then three-mile intervals were used.

Snowstorms and prairie fires hindered progress in September. Surveyors had narrow escapes from severe burning, or suffocation by smoke. On several occasions men worked desperately all night to keep flames away from tents and provisions. In the dry grass of the plains the backfire method was commonly used. But if the grass was long, a rapidly-spreading fire was particularly dangerous as it soon became impossible to gallop horses through the flames without seriously burning the animals. Through experiences such as these a number of the surveyors developed into expert plainsmen. Their lives, unlike those of the native inhabitants, took on a strange two-world aspect, related on the one hand to primitive frontier conditions, and on the other hand to a distant but well-remembered sophisticated civilization.

During this first summer of surveying in the western interior another source of friction developed between Cameron and Campbell. The Britisher, against the views of his own chief astronomer, urged that the boundary line take the form of a mean parallel, formed by averaging local variations at all astronomic stations and thus producing a more perfect curve, as befitting a parallel of latitude. There had been unanticipated complications in the measurings. On the parallel, distinct deflections of the direction of gravity were detected by the surveyors of both nations. These were not surveying "errors" in any ordinary sense of the term but rather were deflections from theoretical directions computed for homogeneous earth. Actual findings did not agree with the theoretical values used by the boundary surveyors. In the vicinity of Turtle and Pembina mountains and near the Sweet Grass Hills (in northern Montana almost directly south of Medicine Hat, Alberta) results indicated that the actual directions of gravity were deflected from the theoretical values toward these topographical features.

Greene, the American surveyor, remarked in his final report:

"Having given the actual deflections it now becomes interesting to see how far these can be accounted for by the attraction of masses above the surface, and how many of them must be referred to some attracting force under ground where, according to Pratt 'we seem to have an unlimited resource upon which to draw, to explain any anomalies of local attraction we may perceive on the surface'." Greene added this comment, "It may seem strange at first that the distant attraction should be so much larger than those nearer the station; but this must always be so in a country like the plains east of the Rocky Mountains, where there are few abrupt irregularities but where large tracts of country have a gradual tilt in the direction of the drainage."[11]

Cameron, in his final report and in reviewing this novel development, pointed out that the definition of the line was complicated by the fact that "from some influence, supposed to be due to irregularity of direction in the action of gravitation upon the levels of astronomical instruments" the points successively determined by the astronomers were not located where they were expected to be, namely, on the 49th parallel. This was a reason why Cameron had advocated the establishment of a regular mean parallel, averaging out the determinations to avoid "a possible excess of irregularity in the course of the boundary line". In other words, Cameron was insisting that a mean or average parallel of regular curvature, run after all determinations had been made, was preferable to a series of curved lines joining astronomically-determined points the location of which was subject to certain irregularities. When Campbell, the American commissioner, at first proposed that the boundary be run as a series of straight lines representing arcs of great circles, Cameron rightly objected that such arcs, drawn on the proposed pattern of inscribed polygons, would range north of the 49th parallel, conceding to the United States about 100 acres every 20 miles. He saw no reason why a circumscribed polygon pattern could not be chosen, with arcs tangented to or south of the 49th parallel so that Canada would benefit from the acquisition of areas of a similar size. Whereupon the commissioners agreed that the line should everywhere have the curvature of the parallel 49 degrees north, between marked points.

Anderson, concerned over Cameron's interpretation of the treaty provisions and the support given by the Canadian cabinet to his view, quietly communicated during the winter months with his friend Wilson in Whitehall. Wilson advised cabinet circles in London that the question of a mean parallel had arisen during the boundary surveys of 1857-62 and that both Hawkins and Haig had been opposed to the procedure on the grounds that resulting territorial adjustments could not justify the heavy costs of running such a parallel. The Astronomer Royal, when consulted by the Foreign Office, ruled in favor of the United States' view that a series of points could be determined with sufficient accuracy by astronomic means to satisfy and implement the terms of the treaty. As to the dispute over the precise location of the most northwestern point of the Lake of the Woods, Wilson advised that Tiarks' determination of 1825 was the only alternative to accepting the site of the remains of Thompson's reference monument and the adoption of such a point would give the Americans even more territory.

Near the end of the 1873 field season some misgivings arose in Ottawa over financial aspects of the boundary survey. The attention of the Canadian cabinet, at the instigation of Minister of the Interior A. C. Campbell, was drawn to the fact that Cameron's expenditures up to June 30, 1873, representing costs of surveying activities, totalled $111,283.37. The cabinet complained that Cameron, in making payments for services rendered the expedition, was acting entirely on instructions from Whitehall. Despite the fact that the Canadian government was responsible for one-half of all project expenditures, no supervision of these operations by Dominion authorities had been arranged. It was accordingly recommended by the cabinet in Ottawa that "steps be taken to bring the subject under the attention of the Right Honorable the Secretary of State for Foreign Affairs with a view to obtaining such right of supervision of Captain Cameron's expenditure and accounts as may be called for in the interests of the Dominion." This was a salutary step and heralded much firmer demands in the future from Ottawa for a more influential and effective voice and control in matters directly affecting the important interests of the Dominion.

All in all, however, the 1873 boundary survey season had been a pronounced success. Anderson, at the beginning of October, in his final reconnaissance of the season, selected a site for the first British astronomic station to be established on the 49th parallel for the following season's work. This was located at a point 432 miles west of Red River. The Americans, who had pushed their topographic survey to a point 385 miles west of Pembina, concluded their summer surveys at about the same time as the British.

The 1874 field program for the British involved an advance to the westward of some 450 miles before actual surveys could commence, and an 850-mile return trip to base camp in the autumn. Logistics of this project demanded close study and careful preparation. Plans were even made for wintering some fifty men near the Rockies if the 1874 surveys failed to complete the boundary-marking assignment.

During the winter of 1873-74 Greene, the American, marked the 49th parallel for 56 miles east of Red River, cutting a swath, where necessary, to a width of 10 feet. In the main he accepted as accurate the British lines of survey in the region. At the end of January, 1874 he returned to Pembina. Except for a second trip by D'Arcy east to the Lake of the Woods, no other boundary surveying or exploring was undertaken until after the spring break-up.

On May 20, 1874, the main British expedition of 11 officers and 128 men left Dufferin for the west country. Before the initial survey stations were reached Rowe, in a fall with his horse, suffered a skull fracture and was incapacitated for most of the field season. Dominion land surveyor Ashe took Rowe's place and the topographic party under his charge began work beyond West Poplar Creek. Because Congress had delayed voting the survey appropriation until early June, the Americans were late in commencing their boundary line operations. They were escorted in this final season by five companies of infantry and two of cavalry. It was June 29 before Greene, for instance, reached the place where his topographical survey had ended in 1873.

Past countless clusters of bison bones, bleached and melancholy reminders of man's careless destruction of the species, almost to the point of extinction, the cairn-marked boundary line advanced steadily to the west across the three principal prairie steppes. Neither insect pests, hailstorms, violent winds nor grass fires impeded for long the onward march of the determined surveyors although smoke, haze and shimmering heat waves made the tasks of these dedicated measurers doubly hard.

There was an imposing concentration of men, animals, transport and stores early in August in the Sweet Grass Hills area. These three prominent buttes rose some 3,500 feet above the level of the surrounding plains. More than 500 men formed the highly mobile population of this mushroom community, an impressive white-man oasis in a vast Indian-occupied empire. It was at this place that Cameron and Campbell met again. Cameron was not in the best of spirits, having received instructions from the Foreign Office to accept the site of the remains of the monument, discovered by the two chief astronomers in the Lake of the Woods, as a proper reference to the most northwestern point there. He had been instructed also to agree to an astronomical, rather than a mean parallel along 49 degrees north latitude.

The somewhat less than enlightened treatment by Americans of the plains Indian of the United States brought its inevitable bloody climax at Little Big Horn, in what is now Montana, in June, 1876, when Sitting Bull and Crazy Horse, supported by a thousand enraged Sioux warriors, massacred the Custer force. Among those slaughtered were some of the army units that had safely escorted boundary surveyors through Indian territory in 1873 and 1874. Ironically, the first beneficiaries of the establishment of the border line were Sitting Bull and his braves, fleeing to Canada from American military wrath.

Dominion land surveyors connected with the boundary-marking project received high praise from their British colleagues. Anderson, in his final report, remarked that "To Mr. Ashe especially great praise is due for taking Lieut. Rowe's place in charge of the surveying party at the shortest notice, and he filled this position with credit to himself and with advantage to the Commission. The whole of the surveying operations of the season [1874] devolved upon Mr. Ashe and the Royal Engineers of his party". Anderson also reported that Capt. Featherstonhaugh "speaks very highly of the ability exhibited by Mr. King, sub-assistant astronomer, in the work entrusted to him . . . ".[13]

Cameron reflected something of the awe-struck attitude of the laity in his tribute to the astronomical observers who, independent of one another, "seeking on the earth's surface, points which are defined by their position relative to the equator, taking the stars for guidance" differed only in their calculations by distances less than the width of a narrow country lane.[14] In 71 days of surveying in the 1874 season Ashe and his party completed 362 miles of boundary line and surveyed all prominent streams, valleys and ridges in a belt of country varying in width from three to six miles, north of the 49th parallel. King, aided by Ashe and his party, cut through more than 24 miles of wood in the vicinity of Turtle Mountain. In the two seasons of surveying in the western interior 857 miles of traverse had been chained. Much of the surveying was carried out on the basis of a gruelling 12-hour work day. Men would leave camp at about 6 a.m., carrying their lunch with them and eating it on pony-back, returning to base about 6 p.m. Survey parties, in the nature of things, could not make extended stops such as astronomic parties were required to do, but were ever on the move.

The services of Crompton, as well as of Rowe and East, proved highly useful. Crompton, a topographer, performed duties of a reconnaissance officer and made observations and sketches. Cameron had special praise for Capt. Abney, R.E., Professor of Photography, School of Military Engineering at Chatham, England, for his carefulness and ability in the selection and use of photographic equipment of the British expedition. A total of 234 photographs illustrated the nature of the country traversed.

Capt. Featherstonhaugh located his final astronomic station at the Belly River crossing, 748 miles west of Red River. The most westerly monument of the earlier Hawkins-Campbell survey, erected in 1861, was reached by Anderson on August 18, 1874. By the end of August all parties of the expedition had commenced the long trek back. The main British party arrived at Dufferin on October 11.

Cameron, with his family, remained in the winter quarters while he brought the affairs of the British expedition to a conclusion. The four officers, Anderson, Featherstonhaugh, Galwey and Ward, gathered in Ottawa to complete their maps and to write reports. Six men from the ranks of the Royal Engineers accompanied them as clerks. Capt. Anderson dined at Rideau Hall, a guest of the Governor General and Lady Dufferin. The astronomer, who was favorably impressed by the appearance of Canada's capital, was also a guest of Prime Minister Alexander Mackenzie.

Some time later Anderson dined in Washington with the British ambassador to the

United States, Sir Edward Thornton. This function served also as a farewell to Mr. Charlton of the British Embassy staff, who was about to leave for England with his bride, daughter of the United States boundary commissioner. Campbell, having had his way in the matter of retaining the Lake of the Woods peninsula from the British during the survey project had, on the other hand and by the irony of circumstances, lost his daughter to one of them.

In summary, 388 monuments and marks had been established by the commissions along the parallel, as well as 40 astronomic stations. The former included iron pillars, stone cairns, earth mounds, timber marks as well as mounds of mixed earth and stone. The cost of the American survey project was slightly in excess of $300,000. The total of British expenditures is not mentioned in Cameron's report but undoubtedly it exceeded £100,000 and may well have reached £150,000. Included in this outlay was the cost of publishing in Montreal 1,000 copies of Dawson's 1875 report. A set of 24 topographic maps, in duplicate, on the scale of 2 miles to the inch, was prepared along with a descriptive list of the monuments and marks. These were submitted to the final meeting of the commissioners in London on May 29, 1876. For their services on the boundary survey Major Cameron and Capt. Anderson received the award of Commander of St. Michael and St. George (C.M.G.) from Queen Victoria.

Cameron, who became a Major General, was Commandant at Royal Military College in Kingston from 1888 to 1896. Cameron Lake and nearby Cameron Falls, scenic attractions in southern Alberta, commemorate his services to the boundary survey project. Anderson Peak in the Rockies in that vicinity is named after Cameron's chief astronomer. Mount Galwey and Mount Boswell are other impressive memorials in the Canadian Rockies to members of the British Commission of 1872-76. In Glacier National Park, Montana, Mount Campbell stands as a natural monument to the work of the United States Commissioner.

It was a great constructive task, as remarkable as it proved lasting. In total length and durability the 49th parallel across the western interior of North America stands unique as an international boundary following, not natural features, but a strictly geographical concept —a line astronomically, legally and geodetically surveyed.

The establishment of the boundary provided Canada and the United States with the first legally enforceable basis for governmental control of offences arising out of lawless international activities in the Midwest. Bootlegging and gun-running, horse-stealing and illegal actions of that nature were at once made subject to more effective policing. The North West Mounted Police found that the completion of the first surveyed line, demarcating the border-line between the two countries and extending fully across the great plains, made possible and practical the administration of law-enforcement in its international aspects.

Boundary Resurveys in the Early 1900s

Point Roberts to the Most Northwestern Point, Lake of the Woods

In the closing years of the 19th century there was a marked increase in discoveries of mineral deposits in the vicinity of the border between Point Roberts and the summit of the Rocky Mountains. The resulting need to locate mineral claims accurately in relation to the boundary line inspired the despatch of urgent pleas to Ottawa and Washington, D.C. to arrange for a more complete and more readily discernible demarcation of the International Boundary from coast to coast. As a more intensive definition of the boundary between the Strait of Georgia and the summit of the Rocky Mountains was particularly pressing, a joint Canadian-United States examination of the line was made in 1901 and 1902. In the latter year, and again in 1903, through an exchange of notes, the two countries jointly made provision for a ground retracement of that section of the boundary. The commissioners responsible for the efficient discharge of the task were W. F. King, Chief Astronomer, Department of the Interior, acting for Canada; O. H. Tittmann and C. D. Walcott for the United States. In sharp contrast to arrangements made for Canada-United States boundary surveys of the previous century we find, on this occasion, a Canadian citizen, recommended for the post by a Canadian cabinet, placed in the position of highest responsibility opposite American counterparts.

In each field season from 1901 until completion of the project, the boundary survey parties, Canadian and American, worked concurrently on the task assigned to them and always on terms of cordial comradeship. In that first season two Canadian field parties were active, headed by Dominion land surveyors J. J. McArthur and W. F. O'Hara. The former's party concentrated on the Point Roberts area while the latter's operated inland toward the Similkameen River. Reginald A. Daly, a geologist, and J. M. Macoun, the naturalist, were attached to McArthur's party. J. M. Bates, E. T. de Coeli and J. W. McArthur performed duties as survey assistants. With O'Hara were Bruce Strachan and J. M. Sheppard along with 12 helpers. Sheppard worked in each season of this boundary-marking project, specializing in monumentation. In the 1902 season T. A. Davies, who obtained his Dominion land surveyor's commission a few years later, served with O'Hara also.

In 1903 one Canadian party and two United States parties were in the field west of the summit of the Rockies. O'Hara had 23 men with him that season, including de Coeli and Wilmot M. Tobey, a Dominion land surveyor who later became a Dominion topographical surveyor. In 1905, as in the previous year, McArthur's party of 60 men included Samuel H. Bigger, S. S. McDiarmid and Noel J. Ogilvie, all Dominion land surveyors. T. A. Davies specialized in photo-topography that season. Trail cutting, topographic work, monumenting and triangulation were carried out. In the 1906 season Bigger was stricken with acute appendicitis soon after surveying began. He was rushed to hospital but died on July 6. The triangulation work, which was to have been accomplished under his direction that season, had to be postponed.

By the end of the 1907 field season about three-quarters of the boundary work between Pacific tidewater and the summit of the Rockies had been completed and readied for joint Canadian-American inspection. This inspection was carried out by Noel J. Ogilvie for Canada and C. H. Sinclair for the United States. Despite trying conditions including heavy windfall, violent hail and snowstorms as well as extremes of temperature, steady progress was made. Once a pack horse, carrying the party's cook stove, lost its footing on a rocky trail and rolled 200 feet down the mountainside through tangled brush. Surprisingly, neither horse nor packload was damaged. But it required a day's hard toil to cut a path to recover the animal and its load. Afoot and on horseback the two inspectors travelled a total of 1,400 miles.

Early in the field season of 1908 boundary retracement work had been completed and found satisfactory. The surveyors and their helpers had overcome many hazards. Forest fires and streams in full flood had caused serious delays; transportation of supplies along hazardous trails presented formidable challenges to man and beast and the moving of heavy monuments and bags of cement in rough country had been exceedingly difficult.

In April of 1908 a treaty was concluded at Washington, D.C. It declared, in part:

"It is agreed that each of the High Contracting Parties shall appoint, without delay, an expert geographer or surveyor as a Commissioner . . . to render more effective the demarcation of the existent boundary . . . and . . . shall observe the . . . protocol of the final meeting, dated May 29, 1876, of the Joint Commission . . . as follows:

. . . 2. In the intervals between the monuments along the parallel of latitude, it is

FIGURE 75
B.C.-Montana boundary vista cut through forested area.

agreed that the line has the curvature of a parallel of 49 degrees north latitude; and that such characteristic shall determine all questions that may hereafter arise with reference to the position of the boundary at any point between neighboring monuments".

Preliminary investigations by Canadian and United States engineers proved the general reliability of the line as originally surveyed and also that the locations of original marks were all recoverable. Thus the way was opened to a complete retracement and re-monumenting of the line, cutting of vistas, execution of triangulation network for topographic control as well as the production of maps of the entire boundary. The agreement also authorized surveyors to adjust all monument positions so that these fitted into the general North American triangulation net or, expressed in more technical terms, "to the North American geodetic datum."

East of the Rockies the forces of nature were in an uncooperative mood and problems arose to plague the survey parties. Severe flooding conditions in streams and rivers of the high plains were followed by swarms of torturing mosquitoes. A Canadian party was the only one active in the field of boundary surveys during the 1908 season. It was accompanied by F. D. Granger, a United States representative. Mr. Granger, in fact, continued to carry out his observing functions for a number of seasons. Various Dominion land surveyors performed similar duties from time to time with American field parties during these years: J. L. Rannie, D.T.S., George W. R. M. White-Fraser, D.T.S., also T. H. G. Clunn and M. F. Cochrane. In the 1908 season the Canadians worked from Coutts, Alberta, along 100 miles of boundary as far as Lodge Creek near the Alberta-Saskatchewan border. Americans, in the following season, surveyed from the summit of the Rockies to Coutts, a distance of about 90 miles.

J. J. McArthur headed the Canadian field party in 1909 and again in 1910. Francis P. Steers, a Dominion land surveyor also, was with McArthur during this period. By early November, 1911, the Red River had been reached. This represented the goal of Canada's effort on the boundary retracement project. Vistas had been cut and cleared on the east slope of Turtle Mountain and through the wooded area of the Pembina Mountains. About one-quarter of the original cast-iron monuments, having been broken or in disrepair, had to be replaced. A number of the field party fell victims to a typhoid outbreak and were hospitalized in Morden, Manitoba. J. W. Menzies, a Dominion land surveyor, was with McArthur in the final field season on this work. In 1912 the Americans carried the boundary survey from Red River to the Lake of the Woods.

In all, 653 new intermediate points had been established where previously there had been only 3-mile intervals between markings. All new points, as well as old cairns and mounds had been newly identified by means of iron monuments. From the North Branch of Milk River to Akamina summit, aluminum-bronze monuments, similar to those used west of the Rockies, had been installed. These monuments were made in three sections in the interest of portability in mountain areas.

Certain recommendations concerning boundary marking, made by the 1908 commissioners, were embodied in the treaty concluded by Canada and the United States in Washington, D.C. in 1925. Their recommendations included a revision of the most northwestern point in the Lake of the Woods, namely, a transfer of that location, by nearly one mile, to the south of the point formally agreed upon as valid in 1876. This alteration resulted in the surrender to Canada of two tiny areas of United States waters in the North West Arm of the lake. These areas totalled two and a half acres in extent and were entirely surrounded by Canadian waters. By Article One the parties to the treaty agreed "that this most southerly point of intersection, being in latitude 49° 23′ 04″.49 north and longitude 95° 09′ 11″.61 west shall be the terminus of the boundary line . . . in lieu . . . of . . . the Northwestermost point." The geographic coordinates of this key point of the boundary surveys, as cited in the 1925 treaty, differ somewhat from the coordinates accepted by the 1876 commissioners, then stated to be latitude 49° 23′ 50″.3 north and 95° 08′ 57″.7 west.[15]

The 1925 treaty also implemented a recommendation that a system of straight lines between boundary monuments be adopted. Article Two stated in part:

" . . . whereas the average distance between adjacent monuments . . . is one and one-third miles and therefore the deviation of the curve of the 49th parallel from a straight or right line joining adjacent monuments is, for this average distance between monuments, only one-third of a foot, and in no case does the deviation exceed one and eight-tenths feet; and whereas it is impracticable to determine the course of a line having the curvature of a parallel of 49° north latitude on the ground between the adjacent monuments . . . and whereas it is desirable that the boundary at any point between adjacent monuments may be conveniently ascertainable on the ground, the Contracting Parties, in order to complete and render thoroughly effective the demarcation of the boundary between the United States and the Dominion of Canada for the Northwestermost Point of the Lake of the Woods to the summit of the Rocky Mountains . . . the boundary shall be defined as consisting of a series of . . . straight lines joining adjacent monuments . . . ."[16]

Although, strictly speaking, the curving parallel was intended to be the international boundary in the western interior, once boundary monuments had been installed at one-mile intervals the amount of land involved in the separation between straight lines connecting such monuments and the curved line of the 49th parallel connecting those same monuments, was without any practical territorial significance. But the result would have been quite different if any boundary monuments had remained 20 miles apart. As has been pointed out, if the original American proposition concerning straight-line courses had been accepted Canada could have lost to its southern neighbor as much as 100 acres every 20 miles.

Lake of the Woods to Lake Superior

The re-establishment of the Canada-United States boundary from the Lake of the Woods to Lake Superior was based on the location of the line in that region and shown on maps prepared in 1826 by David Thompson and William Bird, surveyors to Commissioners Barclay and Porter under Article 7 of the Treaty of Ghent. The section from Lake of the Woods through Rainy Lake had been agreed upon by Barclay and Porter and the line was shown by a black line drawn through the watercourses, traced in red on the Canadian side and in blue on the American side.

The section from Rainy Lake to Lake Superior was agreed to in the Webster-Ashburton treaty of 1842 and shown by them on the same maps by a red line. The maps of the surveyors were severely simple, drawn on a scale of one mile to the inch. They depicted little more than the boundary line and adjacent shore lines of boundary lakes and rivers. No records, other than these maps, could be found of the original boundary surveys in this section, except the journal of the commissioners in which parts of the boundary were described in relation to certain islands.[17]

The task of this new survey, commenced shortly before the outbreak of the First World War, was to prepare improved topographic maps showing the true positions of islands and of other natural features. The tentative boundary line was then to be drawn on the maps in a series of straight-line courses in order to conform as nearly as possible to the curved boundary line shown on maps of 1822-24. After careful checking the line was accepted by the 1908 treaty commissioners. Geographic positions of boundary turning points were then accurately determined by triangulation.

So far as Canadian participation in this area was concerned the boundary survey work extended mainly over the seasons 1912 to 1916 inclusive. Even before that period, in 1896, a preliminary examination and report of this section had been made by an engineer acting under the instructions of Chief Astronomer King of Canada. American survey parties worked from Lake Superior westward in the field seasons 1908 to 1912 as well as in 1917 and 1918. By the latter year the principal task in the region had been accomplished. But minor surveys and miscellaneous monumenting continued to be performed by American parties in the seasons 1921, 1922, 1925 and 1926.

Canadian boundary surveyors made their first appearance on this project in May, 1912, in the Angle Inlet of the Lake of the Woods. The Canadians that year and during several succeeding field seasons were in charge of J. J. McArthur. He was assisted by Dominion land surveyors F. P. Steers, H. M. Barton and H. P. Moulton as well as by J. M. Perrier, A. Albrecht and 12 helpers. The United States representative on Canadian survey parties during this period was F. D. Granger.

The Canadians moved about on the job in two motor boats and several small craft. Throughout the first season their work was often delayed by heavy rains and high winds. The waters of the lake were frequently rough, and constant care had to be taken to prevent the motor boats from being driven ashore. Monuments at boundary reference points were established along the shores of the Angle Inlet and on islands as far east as Oak Island. All monuments were tied into the triangulation net initiated at the meridian boundary. In addition, topographic and hydrographic surveys were made of the shoreline and deep-water channel.

In the 1913 season the Canadian party made a junction at Bear Island of their triangulation work with that of the United States party moving up from Warroad, Minnesota. From there the Canadians moved to the mouth of Rainy River. Then more mapping, monumenting and triangulation work was done as far as Baudette, Minnesota. In 1914 two Canadian field parties were in operation and surveys were carried on at Lakes Namakan and Sand Point and at Lac LaCroix. By October 25 the main party of Canadians had completed mapping and triangulation to the west of Namakan Lake. At Kettle Falls a junction had been made with the work of the United States party advancing from the west. At the end of the 1914 season a large United States survey party was transferred to work on the Quebec-Maine highlands section. This development left one Canadian and one United States party to carry on with the task.

In 1915 Dominion land surveyor G. T. Prinsep served as chief of the Canadian party. Assistants who had joined the survey during the two previous seasons included G. B. Herridge, J. M. Sheppard, L. C. Nesham, Albert Wilkins, A. A. Brown and G. E. Wait. The parties of the two nations worked from opposite directions in order to meet near Curtain Falls. During the 1915 season a topographic survey, on which plane table and stadia were employed, was made of Little Vermilion and Loon Lakes, part of Lac LaCroix and of Loon River. Spirit levels were run across portages from one lake to the next. On July 23, 1915, commissioners King and Barnard inspected the summer's work and found it good. In cooperation the United States Coast and Geodetic Survey and the Geodetic Survey of Canada ran a triangulation and traverse from Lake Superior to the Lake of the Woods and from there westward to the 98th meridian arc of triangulation at Red River; this work was completed in 1924.

In 1916 a topographical survey was made of the east end of Lac LaCroix, of Bottle River and Iron Lake. With the close of that season's operations in late September the main task assigned to the Canadian commission in the region had been finished. Several small Canadian crews were active on miscellaneous boundary surveys in the area from 1921 to 1926. Prinsep and T. P. Reilly with two helpers constituted the personnel of these parties.

The work accomplished by the surveyors of both nations on the 426 miles of this section of the boundary was prodigious. Approximately 5,100 geodetic positions were determined, 1,382 monuments installed and 1,740 square miles topographically surveyed for the production of 36 boundary maps.[18]

Source of the St. Croix River to the St. Lawrence River

The entire boundary line from the St. Croix source to the St. Lawrence, including waterway courses, had been charted under the 1842 treaty. Land positions had been monumented but, generally, the water line had never been permanently marked before the 1908 treaty. Vistas that had been cut many years previously, had virtually disappeared in new growth. As a result of negotiations between Ottawa and Washington, restorative Canadian and United States survey work had commenced in this section as early as 1906.

These boundary surveys continued during 14 field seasons, including that of 1919.

After the surveyors had closed the last stretch of line in the highlands, final computations revealed that minor amounts of additional field work would be required to make the job a complete one. Some inaccuracies had to be remedied and certain modifications resulting from a decision of the commissioners had to be implemented. These modifications related to the change in method of laying down the boundary line through very narrow streams. This additional field work was carried out by small parties from sections of the two commissions during the seasons 1920 to 1923 inclusive.

Transportation of men and supplies often presented formidable problems. Many swampy sections had to be corduroyed* before horses and sleds could cross them. The entire region was densely forested and weather conditions were not always favorable. In one season, 1917, rainfall averaged one day in three. During the years of the First World War it became very difficult to recruit helpers. Men were scarce and wages were high. In addition it was not easy to persuade available men to accept the uncomfortable conditions inevitable in boundary survey camps of those times. In 1918 the influenza epidemic, that raged on the North American continent, seriously affected the Canadian party. Only three of its members escaped the contagion.

When flat, wooded country was encountered it was necessary to adopt special methods of mapping the topography. In woods and underbrush the elevations were determined by hand levels and aneroid barometers. Contours were located by compass and tape traverse, tied to the triangulation net or to plane table and stadia traverses run along roads, streams and railways.

In five field seasons commencing in 1906, the head of the Canadian party was G. C. Rainboth. With him was his son, George Louis, as well as his brother A. J. Rainboth. George Louis served with his father until the latter's death in November, 1910. Thomas Fawcett, D.T.S., then succeeded to the leadership of the survey party. George Louis Rainboth remained associated with Fawcett in this work until the end of the season of 1918. All of these men, save A. J. Rainboth, were Dominion land surveyors. Edward Joseph Rainboth, president of the Dominion Land Surveyors' Association in 1888, was a brother of G. C. and A. J. Rainboth. In addition to J. L. Rannie, D.T.S., other Dominion land surveyors active at one stage or another on this section of boundary work were G. T. Prinsep, J. D. Craig, H. F. J. Lambart, W. M. Dennis, T. C. Dennis, C. R. Westland, F. H. Mackie and John Allan Pounder (1892-1952). The latter's brother, Irvine R. Pounder was an assistant as were B. Foley, D. F. Chisholm, O. Sills, F. P. Reilly, A. M. Phillips, L. La Ferme, R. Tuite, J. Bowie, W. J. Sharpe, R. M. Sheppard, L. C. Nesham, W. Smith, J. N. Ingersoll and V. R. Davies. The latter became a Dominion land surveyor in 1922.

The entire 670 miles of boundary line from the source of the St. Croix River to the St. Lawrence River, including waterway courses, had thus been resurveyed and re-monumented and newly mapped. New Brunswick's share of the distance covered was 164.1 miles; that of Quebec, 506.2 miles. Also involved in the project were the northern boundaries of Maine, New Hampshire, Vermont and New York. A total of 4,204 monuments and 548 reference marks along boundary streams had been installed. On all straight-line courses monuments had been set frequently enough to permit easy sighting from one to another. A total of 61 map sheets was produced from these surveys, the belt of topography shown averaging one-and-a-quarter miles.[19]

Source of the St. Croix to the Atlantic Ocean

It is surprising that not until 1908 and the immediately succeeding field seasons was any precise delineation made of the water boundary between Canada and the United States from the source of the St. Croix to the Atlantic Ocean through Passamaquoddy Bay. The boundary commissioners in 1798, authorized to act as such under the terms of Jay's Treaty concluded four years previously, prepared a general map of the St. Croix River but were not instructed to lay down or mark on the map a definite line of demarcation. Nor were King and Mendenhall, boundary commissioners under the 1892 convention, authorized to do so. They were instructed to designate the course of the boundary in Passamaquoddy Bay but were unable to reach an agreement. They reported separately to their respective governments. By virtue of the first two articles of the 1908 boundary treaty, the original establishment of the International Boundary line in the St. Croix and through the Bay to the Atlantic was entrusted to the commissioners named under that treaty.

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*Corduroying: surfacing an unstable roadbed by logs laid laterally in close formation.

Field operations during the seasons 1908 to 1913 inclusive, also from 1917 to 1919 inclusive as well as in 1921 and 1922, were conducted in cooperation by Canadian and United States parties. Their work consisted principally of establishing control stations near the boundary line by triangulation and traverse surveys tied to stations of the United States Coast and Geodetic Survey. All monuments and range marks were to be fitted into the North American geodetic datum. This work involved compilation of 1,900 geodetic positions, data of real, continuing value to agencies of the two national governments as well as to engineers and surveyors as a foundation for other, more extensive surveys of the region adjacent to the boundary.

Provision was made in the 1908 treaty whereby the course of the boundary in the St. Croix River was to be "a water line throughout" and "to follow the centre of the main channel or thalweg* as naturally existing, except where such course would change or disturb, or conflict with the national character of an island as already established by mutual recognition and acquiescence".

Considerable data, useful in determining the thalweg, had been accumulated from 1889 to 1893 by means of hydrographic and topographic surveys by the United States Coast and Geodetic Survey. The river and Chiputneticook Lakes as far north as the mouth of Monument Brook had been thoroughly sounded. The commissioners decided to accept the data for this purpose. Determination of the main channel in Monument Brook was undertaken in 1921 as well as of the water connection between North Lake and Grand Lake.

The line of the main channel was then drawn on hydrographic maps and boundary turning points so located that straight-line courses joining those turning points formed a close approximation to the course of the channel. Boundary reference monuments were then set in appropriate locations along the river's banks. Boundary turning points, as such, were not actually marked. Location of the boundary from Milltown to the head of tidewater as far as Calais, Maine, and St. Stephen, New Brunswick, was made on the basis of 1918 surveys.

Field work was commenced in the late summer of 1908, consisting of general reconnaissance work and the establishment of a number of triangulation stations. Operations resumed in June, 1909, by a United States party of 3 men and a Canadian party of 10 working in conjunction, each on their own side of the St. Croix River. A. J. Brabazon of Portage du Fort, with assistants C. R. Westland, C. H. Brabazon and A. J. Rainboth formed the nucleus of the Canadian party that season. Brabazon, the party chief, and Westland were Dominion land surveyors.

In 1910 the Canadian party of 14 men camped initially at Upper Mills, New Brunswick, continuing the work of the previous season. The principals of this field party remained the same as in the 1909 season except Rainboth, whose name does not reappear in the records of this series of boundary surveys. His place was taken by the Dominion land surveyor, J. W. Menzies.

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*Thalweg: the line of deepest soundings in a watercourse. In international law, the main navigable channel of a waterway that constitutes a boundary line.

Where the river was relatively narrow and where dense timber stands occurred, the control points were determined by transit and tape traverses run from the nearest major stations rather than by triangulation.

In 1911 the Canadian party worked northward along Spednik Lake, establishing boundary reference monuments. Triangulation work on Spednik and Mud lakes was completed by the Canadians in 1912. A transit and steel tape type of traverse was run southward along Monument Brook.

The major operations of both Canadian and American parties in 1913 were on Passamaquoddy Bay. The Canadians also made a plane-table survey of the St. Croix River at Milltown and took soundings to determine the main channel of that part of the river.

No further boundary survey work took place in this area until 1917. As more comprehensive surveys were completed on other parts of the long boundary, along the 49th parallel, on waterways between Minnesota and Ontario, and along the highlands between Quebec and the United States, it was realized that the work previously done in the St. Croix-Passamaquoddy Bay section should be brought up to the survey and monumentation standards attained elsewhere. The commissioners decided that a complete topographic map should be made of that boundary area, additional boundary reference monuments installed and range marks in the Bay rebuilt. With the exception of mapping islands in the Bay, all this improvement work was allotted to the American commission. The Canadian representative accompanying the United States parties, during the seasons 1917 to 1919 inclusive, was the Dominion land surveyor, T. C. Dennis. The Canadian commissioner at this time was represented by A. J. Brabazon. In 1921 and 1922 the Canadian representative was J. A. Pounder, also a Dominion land surveyor. Over all these years American field work was inspected on separate occasions by Dominion land surveyors T. C. Dennis, J. D. Craig, J. A. Pounder and J. J. McArthur. In the 1922 season, when Canadian field parties conducted topographic mapping of Bay islands, Pounder was in charge of one of them, and G. T. Prinsep was head of the other. D. F. Chisholm acted as assistant.

The final boundary maps consisted of a series of 18 sheets, the maps being constructed on the polyconic projection on scales of 1:6,000; 1:12,000 and 1:24,000, depending on the amount of detail required to clearly show the boundary line. A limited edition of the maps was printed for each national government for distribution to government agencies; libraries and other organizations interested in boundary information.

The water line established from the source of the St. Croix to the Atlantic consisted of 1,103 straight-line courses joining numbered boundary turning points. A total of 256 reference monuments was established as well as 48 range marks on the shores of the Bay. The total length of the boundary line thus marked is 154.63 miles, 25.24 miles of which are through Passamaquoddy Bay. The work was completed under boundary commissioners Noel J. Ogilvie for Canada and J. W. Van Wagener for the United States. The entire task had the valuable aid of the Geodetic Survey of Canada and of the United States Coast and Geodetic Survey. The competent and painstaking work of the Canadians involved in this important project was worthy of the highest commendation.

Canada-Alaska Boundary

(1) *Tongass Passage to Mount St. Elias*: In the 19th century, after 1867, no part of the

far-flung Canada-United States border was so fluid and indefinite as the sector along the northwest coast of America, now known as the Alaska Panhandle. The defining of the 647-mile Alaska-Yukon line along the 141st meridian to the Arctic Ocean had been relatively simple. But southward from Mount St. Elias, the hinge point of the entire boundary and farthest south point of undisputed Russian territory (up to 1867), the problem was immensely complicated. This was a region of incredibly long and deep fiords, flanked by majestic, snow-topped peaks, of glacier-bearing mountains and forests climbing steep hillsides from the water's edge. In addition to the formidable terrain the task of locating the boundary was made abnormally difficult by the vagueness of treaty provisions applicable to the problem. For three decades, as concepts of boundary line location fluctuated, Canadian customs buildings and Hudson's Bay Company posts moved back and forth in an effort to keep continuously within Canadian territory.

In 1867 the United States purchased from Russia, for $7,200,000 in gold, the region now known as the State of Alaska. Following the conclusion of that treaty of purchase, questions arose as between Great Britain and Canada on one side and the United States on the other, as to just exactly what territory had been ceded by Russia in this international transaction. Experts on both sides began to consult historical maps, records of early explorations, statements by public men in the countries affected and the terms of relative treaties in an effort to locate, rationally and precisely, the boundaries of the transferred territory.

The voyages in separate vessels in 1741 of Bering the Dane and of Chirikoff, under Russian auspices, provided St. Petersburg officialdom with at least a vague concept of the outline and extent of Alaska. Later visits to that part of North America by Russian fishermen and fur traders added relatively little to the sum total of their countrymen's knowledge of that territory at the time. Nevertheless Russians were the first to make practical use of Capt. Cook's charts of that part of the world. In 1793 and 1794 Capt. Vancouver explored, with care, the northwest coast of North America. During early years of the 19th century Russians, Englishmen and Americans were exploring and trading along this same coast. Disputes arose constantly over ownership of the *lisière** and adjoining waters.

In 1821 Russia asserted national sovereignty over the coastal areas of the Pacific Northwest as far south as the 51st parallel. Great Britain and the United States were quick to vigorously challenge this declaration and each of these countries conducted its separate negotiations with Russia in efforts to bring about a peaceful settlement of conflicting claims. The Anglo-Russian Treaty on the subject was signed in 1825 and much of the later controversy between Canada and the United States over the location of the Alaska boundary stems from varying interpretations placed upon the highly imprecise terms of that 1825 pact.

Articles Three and Four of the 1825 pact, containing the geographic description of the boundaries of Russian territories in North America as then defined, were inserted in the 1867 treaty by which Russia ceded Alaska to the United States. Not even reputable map makers of that period were well-informed on this area of the world. An 1822 Arrowsmith map, for example, placed the head of Lynn Channel or Canal directly on the 135th meridian. On an Arrowsmith map dated 1833 the same meridian was drawn considerably to one side of the canal. At the time of the Anglo-Russian treaty negotiators were obviously uncertain of the location of the 135th meridian in relation to the head of Lynn Canal. If that meridian, which actually runs through the town of Bennett, had been selected as the permanent boundary then the large part of the canal would still have fallen within Alaska.

In February, 1873, Sir Edward Thornton, British Ambassador to the United States, reported from Washington to the British government that the United States Secretary of State

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*Territory along the edge (of a seacoast).

Hamilton Fish had estimated that the proposed survey of the Canada-Alaska boundary would require 10 seasons to complete and would cost the United States an estimated $1,500,000. United States government engineers, however, reported that in the existing circumstances it would be quite sufficient for the governments concerned to decide upon some particular fixed points, such as the head of Portland Channel (Canal) as well as boundary line crossings of the larger rivers, also at Mount St. Elias and where the 141st meridian crosses the Yukon and Porcupine rivers, leaving the detailed joining up process until some agreeable future occasion.[20]

In November, 1873, following gold discoveries on the Stikine River, Capt. D. R. Cameron (then engaged on international boundary survey work in the western interior of North America) reported, on request, to the Secretary of State for Canada for transmission to London, England, his estimate of costs and of total time required for a "temporarily efficient marking of the line from the southermost point of Prince of Wales Island to the Arctic Ocean". Cameron reported that, in his view, the project would require two to seven years to complete and that the cost would not be less than $425,000 and not more than $2,230,000. Congress, however, failed to make an appropriation to provide for American participation at the time and the matter was dropped.

In November, 1876, an incident occurred in the North West that profoundly influenced the direction and pace of boundary-marking developments in that region. One Peter Martin, a citizen of the United States, was arrested at Cassiar in Canadian territory for a criminal offence and was being taken down the Stikine River on the way to Victoria, B.C., the place of trial. In the course of that journey Martin assaulted a guard and escaped. He was recaptured on what Martin claimed to be United States territory. His appeal on these grounds to American authorities resulted in official representations on his behalf to the effect that his captors were without jurisdiction to act as they had in that area. Many questions were thereupon raised concerning territorial rights along the Stikine under the 1825 and 1867 treaties. Eventually Martin was released. But the affair spurred British-Canadian governments into a renewal of requests to Washington for a proper delineation of the boundary line.

The jurisdictional wrangle had also led to action by Surveyor General Dennis at Ottawa. On March 3, 1877 he instructed Joseph Hunter, a civil engineer in British Columbia, to locate on behalf of Canada the boundary-line crossing of the Stikine River. "Generally to take such observations", his authorization read, "as will enable you to lay down with approximate accuracy the crossing of the river [should the same occur within 10 marine leagues* of the coast] by a line in the words of the treaty 'following the summit of the mountains parallel to the coast . . . [la crête des montagnes situées parallèlement à la côte]' ". Hunter's findings were communicated by Ottawa to the United States government and the result accepted as a provisional boundary line, without prejudice to the rights of either government as to the ultimate location of the true boundary.

The first definite official action to arrange for a large-scale international survey of the Canada-Alaska boundary south of Mount St. Elias was authorized under the Convention of 1892. Article One of that agreement provided for a joint survey of the area adjacent to the boundary between 54° 40′ and the west shoulder of Mount St. Elias. Mendenall, later succeeded by W. W. Duffield, for the United States, and W. F. King for Canada, were appointed boundary commissioners and their first meeting was held in Ottawa in February, 1894. A preliminary topographical survey of the principal deep-water passages, including the continental shoreline from the mouth of the Portland Channel to Lynn Channel had been completed by the United States Coast and Geodetic Survey in 1892. This work formed the basis for the coordination of various detached surveys by parties sent out by the two commissioners in the three field seasons 1893 to 1895 inclusive. Canadian surveyors who were in charge of parties on this important assignment included O. J. Klotz, W. Ogilvie, A. J. Brabazon, A. C. Talbot, James Gibbons, A. St. Cyr and J. J. McArthur. Results of these surveys were embodied in 24 maps, produced in addition to 12 maps constructed as a result of American surveys.[22]

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*1 marine league equals 3 nautical or geographical miles, each of 6,080 feet. 10 marine leagues equal therefore 34.55 statute miles, each of 5,280 feet.

In accordance with the photo-topographic method of survey then in limited use, mostly in very rugged terrain, a number of photographic views of the area were produced as well. The summit of Mount St. Elias (Alaska) was found to be slightly over 18,000 feet high, that of Mount Logan nearby (Canada), to be 19,850 feet. The geographical coordinates of Mount St. Elias were fixed at latitude 60° 17′ 35″.10 north and longitude 140° 55′ 47″.32 west. The summit of Mount St. Elias, a boundary point, was found to be 2.41 miles east of the 141st meridian. The boundary then proceeded northwesterly to a shoulder of the mountain and thence north along the 141st meridian.

During the winter of 1894-95 a party headed by Ogilvie ascended Taku River, then negotiated the White and Taiya (Chilkoot) Passes leading from the head of Lynn Channel to the interior. Because of unusually stormy weather the party was compelled to return to its base, having accomplished only a traverse survey of part of the Taku River. During the 1895 field season Brabazon headed a survey in the region between the mouth of the Alsek River and Gokutal Bay, directly south of Mount St. Elias. It is significant to find in Alaska that Brabazon Range commemorates the constructive, daring work of this eminent Canadian in fulfilling his part in joint survey projects in the southwestern part of that State.

Final reports related to this boundary-marking work were signed in Albany, New York, on December 31, 1895, by Commissioners King and Duffield.

The discovery of gold in the Yukon Territory and the resulting rapid economic development in that part of the continent in the closing years of the 19th century made more imperative than ever the official demarcation of the Canada-Alaska boundary on the ground. Delays of a political nature impeded the pursuit of diplomatic efforts to arbitrate the question. Prime Minister Sir Wilfrid Laurier wrote to a friend early in 1899 on the topic of improving relations with the United States:

" . . . The stumbling block was the Alaska boundary. In this our American fellow Commissioners were at first and almost to the last disposed to come to a reasonable compromise. I may tell you confidentially that the compromise was that they gave us Pyramid Harbour on the Lynn Canal with everything but the official sovereignty in name . . . This arrangement provoked such a storm in the Pacific states* that our fellow Commissioners withdrew their consent . . . ".[23]

But pressures for an early solution to the dispute were mounting. In 1901 the assassination of President McKinley brought the aggressive, impetuous Theodore Roosevelt to the summit of authority in the United States. If there was to be arbitration of the boundary issue then, President Roosevelt made it clear, such arbitration must be on the basis of a six-man tribunal, three to be appointed from each side of the dispute. As a Brooklyn newspaper commented at the time "there was as much chance of convincing a tribunal so constituted of the soundness of the Canadian case as there was of a thaw in Hades."[24]

In January, 1903, a convention was signed at Washington by the British ambassador to the United States and by the United States Secretary of State under which an Alaskan Boundary Tribunal would be "immediately appointed" to consist of "six impartial jurists of repute". Three of these were to be appointed by His Britannic Majesty and three by the President of the United States. Optimistically but, as matters turned out, perceptively, the authors of this convention required that decisions on specified questions to be submitted to the tribunal should be reached on the basis of a majority judgment. Judges appointed on the British-Canadian side were Lord Alverstone, Lord Chief Justice of England, Sir Louis A. Jetté, Lieutenant Governor of Quebec, and Allen B. Aylesworth, a Toronto barrister. On the United States side those named early in March were Hon. Elihu Root, Secretary of War, Hon. Henry Cabot Lodge, United States Senator, and Hon. George Turner of the State of Washington, former member of the supreme court of that state.

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*Ports of the Pacific states had flourished in the closing years of the 19th century on trade with the Yukon.

It was a unique body. These nominations marked the first time that an adjudication of an international boundary dispute had been attempted by what was ostensibly a court, composed of an equal number of jurists from each of the sides concerned. The outward forms of judicial procedure were observed and the objective was to arrive at a decision binding on the parties to the dispute. Sessions of the tribunal took place in the Foreign Office building in London, England, and extended from September 12 to October 8, 1903. Eighteen days were required for hearing of the arguments. The tribunal's decision was announced on October 20. As matters developed, Lord Alverstone's views proved to be the decisive factor in the outcome of the arbitration.

The tribunal was asked to render a decision on seven questions:

1. What is intended as the point of commencement of the line?

2. What channel is the Portland Channel?

3. What course should the line take from the point of commencement to the entrance to Portland Channel?

4. To what point on the 56th parallel is the line to be drawn from the head of the Portland Channel, and what course should it follow between these points?

5. In extending the line of demarcation northward from the said point on the parallel of the 56th degree of north latitude, following the crest of the mountains situated parallel to the coast until its intersection with the 141st degree of longitude west of Greenwich, subject to the conditions that if such line should anywhere exceed the distance of 10 marine leagues from the ocean, then the boundary between the British and Russian territory should be formed by a line parallel to the sinuosities of the coast and distant therefrom not more than 10 marine leagues, was it the intention and meaning of the said Convention of 1825 that there should remain in the exclusive possession of Russia a continuous fringe, or strip, of coast on the mainland, not exceeding 10 marine leagues in width, separating the British possessions from the bays, ports, inlets, havens, and waters of the ocean, and extending from the said point on the 56th degree of latitude north to a point where such line of demarcation should intersect the 141st degree of longitude west of the meridian of Greenwich?

6. If the foregoing question should be answered in the negative, and in the event of the summit of such mountains proving to be in places more than 10 marine leagues from the coast, should the width of the *lisière*, which was to belong to Russia, be measured (1) from the mainland coast of the ocean, strictly so-called, along a line perpendicular thereto, or (2) was it the intention and meaning of the said Convention that where the mainland coast is indented by deep inlets forming part of the territorial waters of Russia, the width of the *lisière* was to be measured (a) from the line of the general

direction of the mainland coast, or (b) from the line separating the waters of the ocean from the territorial waters of Russia, or (c) from the heads of the aforesaid inlets?

7. What, if any, are the mountains referred to as situated parallel to the coast, which mountains, when within 10 marine leagues from the coast, are declared to form the eastern boundary?

In the course of the legal arguments heard by the tribunal two main issues emerged. Firstly, what course should the boundary line follow at the mouth of the Portland Channel? Secondly, where did the line run from the head of that channel northward on the mainland to Mount St. Elias? At the time of the 1825 Anglo-Russian treaty the British view was apparently accepted by the Russians, namely, that the crest of the mountains situated parallel to the coast would be the boundary line unless a gap occurred in the range, in which case Russia could claim only up to a maximum of 35 miles inland. The treaty provided an alternative that if such a mountain range proved to be more than 35 miles distant from the ocean, the boundary should follow a line parallel to the sinuosities or windings of the coast and never, at any point, more than 35 miles distant therefrom.

Through the maze of learned arguments the primary question persisted: did any such chain of mountains exist? The Americans maintained that no chain of mountains parallel to the coast, as mentioned in the treaty, existed. The Canadian case was that such a range did actually run near the coast and that a boundary line drawn along their summits would leave many long inlets deep within Canadian territory. This claim to sovereignty was highly important in regard to the Lynn Channel through which an all-Canadian entry by sea to the Yukon Territory would thus become available.

It is hardly surprising that the terms "coast" and "chain of mountains parallel to the coast" as employed in the Anglo-Russian treaty became the objects of conflicting interpretations. This disagreement was reminiscent of the prolonged arguments over the location of the "St. Croix River", the "highlands" of Quebec south of the St. Lawrence River and the disposition of islands between sovereignties in Passamaquoddy Bay. These differences arose mainly from a lack of surveys and therefore of reliable geographic knowledge of boundary areas by those responsible for the ambiguous wording of treaty terms. In the Canada-Alaska boundary dispute it was argued on behalf of the United States that the word "coast" as used in the 1825 treaty meant indentations of every bay and inlet (however narrow) into which tidewater entered. The Americans maintained that the boundary should follow the sinuosities of the coast, that is, the long way around inlets, allowing 35 miles of land between the boundary and salt water. Canadian counsel contended that "coast" meant following the general direction of the shore, by-passing indentations and crossing from headland to headland. The adoption of this view would have meant a drastic narrowing of the coastal strip claimed by the United States.

In contrast to the Canadian position United States counsel insisted that the coastal strip or *lisière* was meant to be a solid, continuing land barrier between the country adjoining it and the Pacific Ocean and that the boundary, whether following a mountain chain or not, must run around the head of every inlet. This, in effect, would deprive Canada of any usable harbor along that coast. One pronounced advantage enjoyed by the Americans in this argument was the fact that the United States, to a considerable extent, had been in actual occupation of the contested strip. A weakness in the Canadian case also was that the Russian assertion and resulting American assumption of an unbroken *lisière* had not been vigorously challenged for a number of years. But the Canadian case appeared strong on the basis of the wording of the 1825 treaty.

In the final outcome of the adjudication Canada failed to win a clear-cut victory on any aspect of its representations. There was, it is true, unanimity among the six judges on the answers to Question One and Question Two. Actually there was little, if any, room for serious differences about the point of commencement of the boundary, namely, Cape Muzon on Dall Island, or over the location of the Portland Channel.

The initial divergence of opinion among members of the tribunal was on Question Three. Four islands of importance lay at the mouth of Portland Channel carrying the names, Wales, Pearse, Sitklan and Kannaghunut. The Canadian judges were incensed when Lord Alverstone joined the American judges to run the boundary line north of Wales and Pearse islands only, then by a sharp, right-angle turn in the line southward, carried it through Tongass Passage and to the *south* of Sitklan and Kannaghunut. By this strange decision these two latter islands were made territory of the United States. The Canadian judges, taken completely by surprise by this majority ruling, had never doubted that the only historic, logical entrance to Portland Channel lay *north* of all four islands. Nor had any contrary formal opinion or claim been made at sessions of the tribunal. One Canadian judge was moved to declare that the tribunal award in this respect was nothing less than "a grotesque travesty of justice".[25]

When Question Five was answered in the affirmative, adjudication of Question Six became unnecessary. Questions Five and Seven were decided on the basis of the same count, four judges to two, with Lord Alverstone joining the three American judges. The two Canadian members strongly dissented and, in fact, refused to sign the declaration of the award.

Although the decision on the existence of a coastal mountain range, conforming to treaty description, favored the Canadian argument, Canada was deprived of any advantage from the finding through the majority action in selecting specific border mountain peaks which, in many instances, were located well inland and considerably beyond the heads of inlets.

There had been rumors, before the tribunal's decision was made public, that Lord Alverstone would side on the important issues of the case with the Americans. Sir Wilfrid Laurier had commented "If we are thrown over by the Chief Justice he will give the last blow to British diplomacy in Canada".[26] The storm of discontent that was aroused in Canada by the decision of the Alaska Boundary Tribunal was fierce, widespread and sustained. Laurier had to face heavy criticism from the parliamentary opposition over his handling of the whole affair and for his failure to safeguard Canadian interests. At the time, however, and in view of the rigid, unyielding American attitude, it represented the only way in which an award could be made by that tribunal. The significant, long-term result of the arbitration was the strong, continuing impulse given to the growing movement in this country to bring about an independent control by Canada of the conduct of its foreign affairs. In the years that followed the award Canada's administration of its relations with other nations was quietly and steadily advanced.

Included in the maps used by tribunal members in making their award were the maps accompanying the joint Canadian-United States surveys of 1893-95 on which they had marked the general course the international boundary was to take. This winding line included Hunter's early line across the Stikine River and the *modus vivendi* lines across White and Chilkoot passes. On the Chilkat River, however, the line was moved about 20 miles upstream to cross Chilkat, Tahini and Kelsall rivers. From a point near Taku River to a point near Stikine River, a distance of about 125 miles was left undefined pending further surveys. By an exchange of notes between the British and United States governments in 1904-05 Commissioners King (Canada) and Tittmann (United States) were authorized to define boundary peaks and carry out delineation of the boundary along the 125-mile gap.

Field surveys for these purposes were started in 1904. The original triangulation and

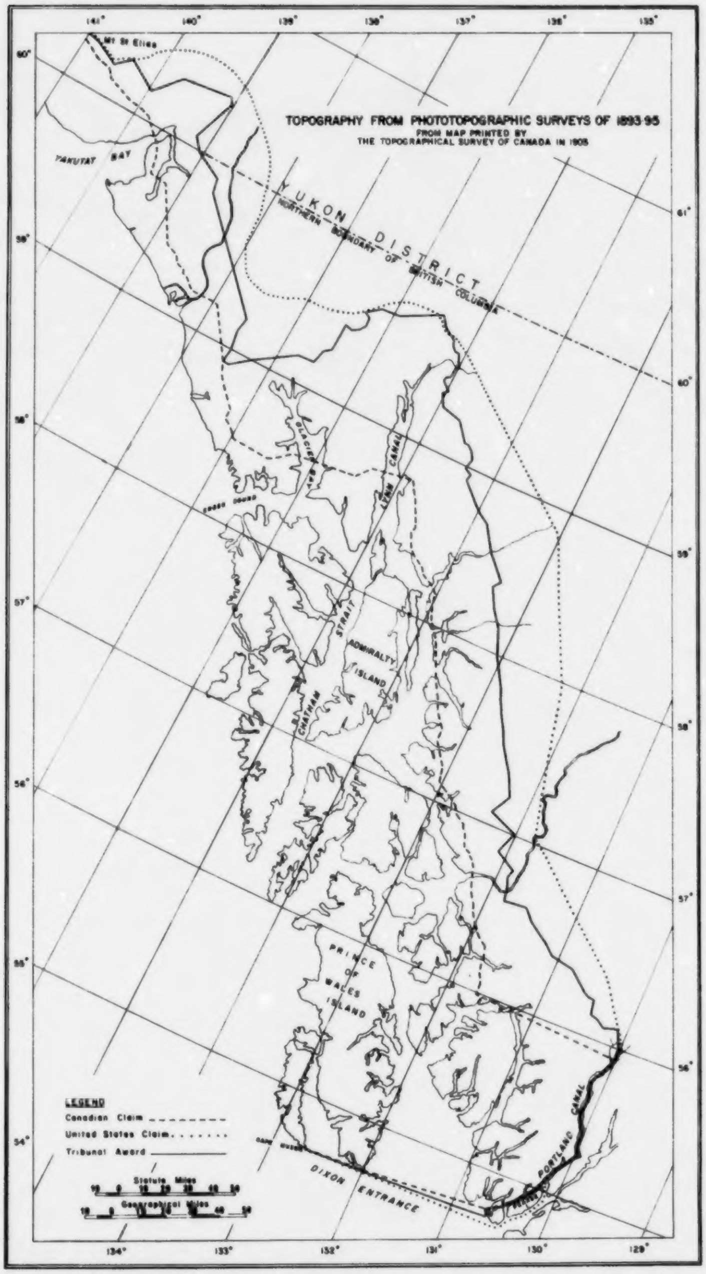

TOPOGRAPHY FROM PHOTOTOPOGRAPHIC SURVEYS OF 1893-95
FROM MAP PRINTED BY
THE TOPOGRAPHICAL SURVEY OF CANADA IN 1905
141°
140°
139°
138°
137°
136°
135°
60°
59°
58°
57°
56°
55°
54°
61°
Mt St Elias
YAKUTAT BAY
YUKON DISTRICT
NORTHERN BOUNDARY OF BRITISH COLUMBIA
GLACIER BAY
LYNN CANAL
CROSS SOUND
CHATHAM STRAIT
ADMIRALTY ISLAND
PRINCE OF WALES ISLAND
DIXON ENTRANCE
PORTLAND CANAL
LEGEND
Canadian Claim
United States Claim
Tribunal Award
Statute Miles
10 0 10 20 30 40 50
Geographical Miles
10 0 10 20 30 40 50
134°
133°
132°
131°
130°
129°

FIGURE 76. Canada-Alaska boundary claims and settlement line along Panhandle.

photo-topography were revised and extended, monuments set at suitable sites to mark the boundary on the ground, and a 20-foot skyline vista was cut through most of the timbered areas. Mountain climbing, navigation of swift glacial streams as well as cautious, tiresome back-packing progress over treacherous glaciers and snowfields were almost everyday experiences during these immensely difficult surveys. The movement of camp equipment, supplies, instruments and materials for constructing monuments was always arduous under such conditions but especially so when these impediments had to be carried to altitudes of several thousand feet. Nearly one-third of the entire boundary region is perpetually covered by snow and ice. As an example of transport difficulties it took packers on the Davies Glacier 8 hours to travel 4 miles. Field work was usually undertaken within a half-day's travel of the base camp. When distances became too great, or routes were so formidable that men could not reach objectives and return to base the same day, a fly camp equipped with barest necessities would be established in a convenient location. Rain, snow and fog were commonly encountered and many uncomfortable days and nights were endured in the makeshift camps.

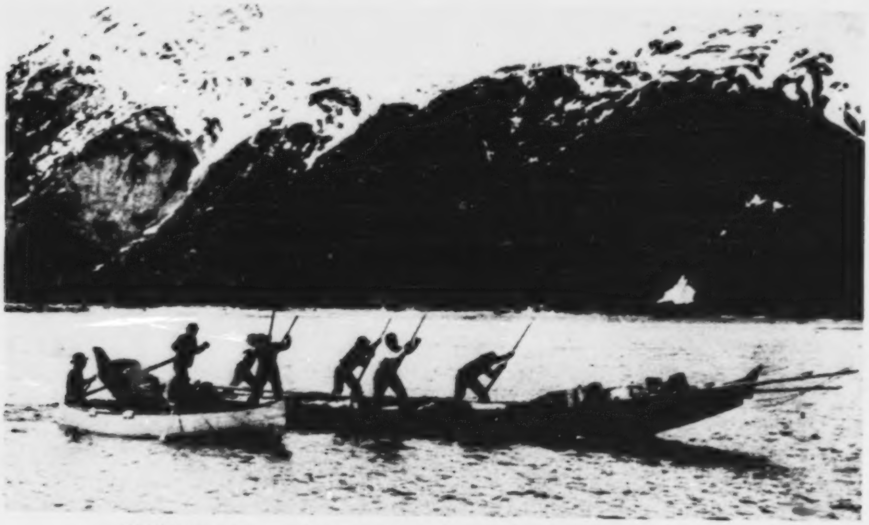


FIGURE 77. Surveyors heading upstream on Yukon River in poling boat, 1910.

Travel over snowfields was usually done early in the morning to take advantage of the surface crust. Although men were roped together and carried alpenstocks, a route that had been quite safe earlier in the day often became extremely hazardous later, especially when deep crevasses had to be crossed on melting snow bridges. Some serious accidents were unavoidable under such dangerous conditions. On two occasions there was loss of life. In 1909 a member of a field party broke through a snow cornice on a mountainside and fell 2,000 feet to his death. In 1913 a landslide buried two light-keepers in their camp at Cape Muzon.[27]

These Alaska boundary surveys between Cape Muzon and Mount St. Elias occupied 12

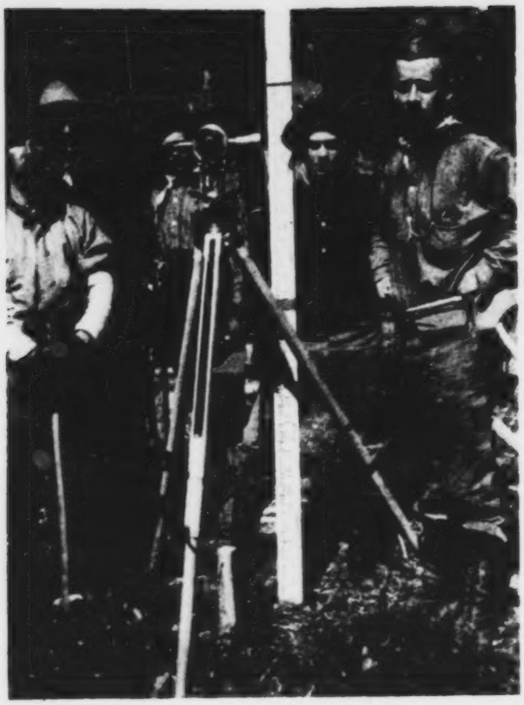


FIGURE 78
Canada-Alaska boundary survey party, 1909. A. G. Stewart at right.

field seasons, 1904 to 1914 inclusive and, later, in 1920. When field operations ended in 1914 it was not anticipated that further boundary demarcation work would be required under the authority of the tribunal award. However, a considerable amount of mining activity developed in 1910 in the region directly north of the head of Portland Channel. As a result additional field work was authorized over the distance between the head of that channel and Blue River.

Dominion land surveyors who were in charge of boundary survey parties in the 12 seasons included C. A. Bigger, George R. White-Fraser, D.T.S., W. F. Ratz, A. J. 'Jack' Brabazon, J. D. Craig, F. H. Mackie, Noel J. Ogilvie, T. C. Dennis and W. Mel Dennis. Other Dominion land surveyors engaged in these boundary-marking tasks who held their commissions at the time or soon afterward included H. F. J. Lambart, A. G. Stewart, D. J. Fraser, C. R. Westland, H. M. Barton and G. T. Prinsep. Dominion land surveyors who acted as Canadian representatives with United States field parties included C. A. Bigger, G. R. White-Fraser, D. H. Nelles, F. H. Mackie, T. H. G. Clunn and J. A. Pounder.

Ottawa-born Alexander George Stewart (1886-   ) has recorded some vivid impressions of the historic 1908-11 surveys along the Alaska Panhandle on which he worked as an assistant and during which period torrential rains and aggressive insects made life miserable at times for surveyors in that wild, mountainous country. There were other formidable afflictions in that region. Stewart has recalled that boundary surveyors "wore gumboots that came up to our hips and these were intended to keep out the icy-cold water. But we would fill them with water deliberately first thing in the morning in order that it would become warm from our bodies and thus serve as insulation . . . ".

"The survey line had to be 20 feet wide. Some of the trees we had to cut were six feet in diameter. We used double-bit axes and seven-foot crosscut saws. We worked ten hours daily, seven days a week . . . Markers had to be placed every three miles in solid rock. We couldn't find much solid rock in some river valleys so we had to pack in cement, gravel and water and then build three-foot-square aprons for obelisk-type monuments. Smaller monuments weighed 56 pounds and stood 2½ feet high and these had much smaller concrete bases. These monuments were made of heavy bronze with *Canada* marked on one side and *United States* on the other."

Mr. Stewart began practice in Edmonton as engineer and surveyor in 1912. Enlisting in 1916 he went overseas with Canadian Railway Troops and helped to build light railways in France, sometimes under heavy fire from enemy guns. Stewart served as chief surveyor, Edmonton land titles office, for many years following the First World War.

In 1912 William Melbern Dennis, in charge of the Canadian survey party during that field season, reported the presence of ice worms at the junction of Grand Pacific and Melbern glaciers. It was on the recommendation of J. D. Craig that the outstanding survey services of Mel Dennis were fittingly recognized through the official selection in August, 1922, of his middle name as the title of this well-known British Columbia feature. Scientific circles excepted, ice worms have long been regarded as purely mythical creatures, symbols of all that is amusingly imaginative in the folklore of the Far North. Dennis was astonished therefore to come upon these brownish, pin-size ice worms on July 4 while leading his survey party in the Glacier Bay region. In the early morning relatively few of the worms were visible and these vanished from sight during the later daylight hours. But in the evening the creatures completely covered the ice surface and were distributed on a pattern of one worm to approximately one square inch where the ice was hundreds of feet thick. On the following day the worms had completely disappeared. Some specimens were identified as belonging to the genus *Mesenchytraeus solifugus*. The Dennis findings have been corroborated by other discoveries. Snow and ice worms belonging to this genus have been classified by science in some 60 known species. Some 21 of these and several varieties have been recorded in North America, all confined to the Pacific slope. Only three or four species of the worm, however, are definitely known to inhabit continuously an environment of only snow and ice. During midwinter the worms are generally inactive and do not appear on the surface until some melting occurs.[28]

William Melbern Dennis (1885-   ), born in Prince Edward Island, was a school teacher in that province and a graduate of McGill University before he took up surveying. He was commissioned Dominion land surveyor in March, 1911, and was assigned by Dr. King to a field party under G. L. Rainboth in British Columbia. Then for several seasons Dennis served in a region very different from the gently rolling fields of his native province. Under Noel Ogilvie he was active on Canada-Alaska boundary surveys for several seasons, including triangulation work in 1914 at Dixon Entrance. His younger brother, Thomas Clinton Dennis (1887-1963) obtained his Dominion land surveyor commission in May, 1911, and was chief of party in 1912 on the Canada-Alaska boundary surveys and, in 1920, was a senior member of the Canadian field party in the same region under J. D. Craig. The Dennis brothers were not related by blood to the first Surveyor General of post-Confederation Canada.

Noel J. Ogilvie (1880-1967) served articles with Deville, McArthur and Edgar Bray. In the 1907 season Ogilvie was Canadian representative on the inspection of boundary survey work between Point Roberts and the Rockies along the 49th parallel. It was toward the end of that season that McArthur wrote to Ogilvie:

"See that you have an opportunity of checking a couple of their long chords. It is definitely mentioned in the Convention that it must be a skyline 20 feet wide throughout. Mr. Tittmann was astounded at the large timber through which our line runs . . . I expect we will have everything cleared up by October 1st. I think we may congratulate ourselves."[29]

On one occasion while mountain climbing on International Boundary survey work Ogilvie met Thomas Riggs, Jr., attached at that time to an American boundary survey field party. Riggs, some years later, became Governor of Alaska. In 1917 Ogilvie was named director of the Geodetic Survey of Canada and, subsequently, was given the title of Dominion Geodesist. In 1931 he was appointed International Boundary Commissioner in succession to J. D. Craig. He continued in the position until 1947. Noel Ogilvie was the last of the Canadian commissioners to be appointed basically through the British Foreign Office. Subsequent occupants of that office have been nominated by the federal department responsible for surveys and then the recommendation for appointment conveyed to the Canadian government by the Department of External Affairs, Ottawa.

The 808.2 miles of the International Boundary running from the entrance of Tongass Passage to the southern terminus of the 141st meridian boundary consisted of 28 boundary turning points on the water portion of the line and these were referenced by 52 monuments. A total of 194 boundary points marked the land section of the line. Thirteen boundary maps accompanied the final report. Latitudes and longitudes are given on the 1927 North American geodetic datum. The map sheets, covering an area of about 32,000 square miles, were submitted with the final report, signed at Ottawa in November, 1951, by the commissioners, J. Leslie Rannie for Canada and John A. Ulinski for the United States. The maps were engraved on copper plates and lithographed in atlas form. The boundary line, monuments and lettering appear in black, elevations and contour lines (other than on glaciers) in brown, drainage in blue including elevations and contours on glaciers, and timber is shown in green. Each map sheet covers one degree of latitude and two degrees of longitude. Sheets are on polyconic projections on a scale of 1:250,000 or about 4 miles to the inch, with contour intervals of 250 feet. In Canada these boundary maps and reports are on file in the Public Archives in Ottawa and in various reference libraries throughout the country.

The photo-topographic method, which had proved its special suitability for topographic surveys in rugged terrain, was used in boundary area surveys after the boundary award of 1903. Between 1904 and 1912 about 700 camera stations were occupied in the Panhandle and some 5,000 photographs taken by Canadian and United States parties combined. In some of the river valleys the plane-table method supplemented the camera.[30]

(2) *Arctic Ocean to Mount St. Elias* (*141st Meridian*): Following William Ogilvie's first boundary surveys in the Yukon in 1887-88, and again in 1895, supplemented and checked by independent boundary surveys in 1889-91, the question of completing surveys along the 141st meridian boundary had remained fairly dormant. In January, 1896, the Canadian government proposed to the United States government that a provisional demarcation of that boundary line be made. Hon. Richard Olney, United States Secretary of State, in a counter-proposal stated that as the differences in measurements between Ogilvie's findings and those of the United States Coast and Geodetic Survey were so insignificant (in one place being only 6 feet, 7 inches) a new Convention ought to be entered into by the two governments under which certain points along the 141st meridian where it intersected principal streams, could be agreed upon, with provision for a junction of such points by joint surveys as occasion might require. This process could be continued until the entire line was finally established. The Canadian government, through Minister of the Interior Daly, substantially concurred in this proposal and notified Washington that it was prepared to commence such work in the 1896 season.[31]

In 1902, following reports of increased mining activity in the vicinity of this boundary, the Ogilvie line from 1888 was extended some 60 miles from Sixtymile River to the flats at the head of Scottie Creek. This 1902 work was accomplished by McArthur. Nothing more was done on the task of surveying the 141st meridian until after the 1906 Convention which, in the main, followed provisions of the unratified 1897 draft.

Tittmann, Superintendent of the United States Coast and Geodetic Survey, and King, Chief Astronomer for Canada, under the authority of the 1903 Convention had been named commissioners in respect to the "Boundary Line, Alaska and Canada".[32] Following the 1906 Convention these appointments were officially confirmed and, in King's case at least, the duties included a specific assignment to that part of the boundary represented by the 141st meridian.[33] These latter joint surveys extended over a total of seven field seasons from 1907 to 1913 inclusive.

FIGURE 79. Boundary monument, head of Portland Canal.

The two commissioners decided that astronomical observations essential to any future Alaska-Canada boundary surveys should be completed during the 1906 season. The sole point on the 141st meridian boundary connected with outside surveys in any way at that time was at Yukon River crossing. The telegraphic connections with Vancouver were made by means of Canadian Government lines and Canadian Pacific Railway lines. Late in July, 1906, Dominion land surveyors McDiarmid and Klotz were sent to the crossing point and to Vancouver respectively. By September 3 of that year, over this 2,000-mile-long telegraphic connection, seven differential longitude determinations were obtained between that point on the 141st meridian and Vancouver. These observations revealed that the Ogilvie line, surveyed in 1878-88 and as marked on the ground, was only 218 feet in error. The relative insignificance of this discrepancy is, in itself, a tribute to Ogilvie's great skill in working out positions despite dependence upon instruments and weather conditions far from ideally suited to his purposes.

In 1887 the journey inland of the Ogilvie survey party, complete with instruments, provisions and two canoes, occupied seven weeks. Twenty years later, in marked contrast to the earlier experience, Canadian and American boundary surveyors loaded their horses and supplies at Skagway on the train of the White Pass and Yukon Route. Then they stepped happily into the relative luxury of first-class coach accommodation and enjoyed the 8-hour trip through majestic mountain scenery to Whitehorse. The surveyors arrived in Dawson by stage on April 13.

In 1907, owing to the lack of Canadian surveyors available for boundary-marking work, the greater part of field activity was undertaken by United States parties. Line-projection work was carried on jointly by a United States and Canadian observer and a Canadian representative was attached to the American triangulation party. On June 24, while working on the banks of the Yukon River, the surveyors detected the body of a man floating downstream. After the body was brought ashore near Boundary Creek the remains were identified as those of Frank McKay, drowned near Dawson three weeks previously. Although an officer of the Royal North West Mounted Police was summoned from Dawson he was unable to handle the case as the body had been recovered in United States territory. It fell to the surveyors to lay the remains to rest behind the old roadhouse near the mouth of Boundary Creek. The United States chief of party read the burial service.[34]

FIGURE 80. Surveyors en route to boundary line, west of Whitehorse, Y.T., 1909.

The country in which the boundary surveys took place was undulating to mountainous and featured by deeply eroded stream beds. Rivers were generally swift and heavy timber was often encountered in the river valleys. Travel was often good along the tops of ridges. Thick moss covering much of the lower country made progress there tiring for man and beast. The very long periods of daylight during summer seasons in these high latitudes aided survey work substantially. Mosquitoes and other insect pests were plentiful but by the use of netting at nights the men were able to secure some rest. Horses, however, suffered greatly from mosquito attacks and only the use of smudges made the lot of the animals tolerable. Wintering of horses in the Territory also presented serious problems during the survey period.

In mid-May, 1908, boundary surveyors were busy again. By that time two aluminum-bronze monuments had been placed, one on each bank of the stream, to mark the meridian crossing of the Yukon River. Meridian points had also been established along a distance of 130 miles. Topographic work was extended southward about 65 miles in the 1908 field season. A Canadian party set 24 monuments, completing their share of the work as far south as Sixtymile River. Projection of the boundary line was carried across the White River.

In the 1909 field season 51 men, of whom 17 were Canadians, and 83 horses made up the joint survey caravan. Topography was mapped by two plane-table parties. Strenuous efforts to occupy certain mountain peaks as camera stations failed. Weather conditions defeated such attempts in the high altitudes. A surveyor gives a graphic account of the results of a day's battling with the cruel climate: "It began to snow, but we had to go on . . . and reached camp at 8.30, worn-out and chilled to the bone and found the tent down and everything wet or frozen. We shovelled away the snow for a small space, with snowshoes, put up the tent as best we could and crawled into our scanty bedding. During the night it snowed 25 inches and continued snowing the greater part of the next day. Even with the coal-oil lamp burning full blast and three men in the little . . . tent, the thermometer registered only 32 degrees."[35] And this was on the 11th of August!

A. J. 'Jack' Brabazon, commissioned as a Dominion land surveyor in May, 1882, was chief of party on the Canadian boundary surveys along the 141st meridian for three field seasons, commencing in 1907. He was the son of Samuel L. Brabazon of Portage du Fort, Quebec, who had been blanketted in as a Dominion land surveyor under the 1872 legislation. His brother, Gerald Hugh Brabazon, although unlisted as a Dominion land surveyor, served in the Dennis Scouts in the Riel Rebellion in 1885. As Conservative candidate in Pontiac constituency he ran in 1900 for election to the House of Commons but was defeated. He was elected in 1904; defeated again in 1908 but re-elected in 1911. In all, G. H. Brabazon served 10 years in Parliament. He was mayor of Portage du Fort for 18 years. Claude H. Brabazon, son of Gerald, was active as an assistant on boundary survey parties in the Yukon and in the Maritimes. A glacier in the Yukon is named after A. J. Brabazon.

In addition to Canadian party chiefs Brabazon, Lambart and Craig, Dominion land surveyors who took part as assistants in this early 20th century work along the 141st meridian included D. H. Nelles, A. G. Stewart, T. C. Dennis, D. J. Fraser and E. W. Nesham. Other assistants were T. P. Reilly, H. S. Mussell and Claude Brabazon.

In 1909 triangulation work was carried from points near Mount Natazhat northward 83 miles to the range of hills in the bend of the Scottie River and connecting with stations established during the previous season. The boundary line along the 141st meridian was projected a total of 50 miles, and 100 miles of vista were cut.

In 1910 J. D. Craig, commissioned as a Dominion land surveyor in February, 1902, became chief of party in succession to A. J. Brabazon and remained in this capacity until the conclusion of boundary surveys by Canadian parties along the 141st meridian line. The main efforts of this fourth consecutive season in the field were confined to carrying work north of the Yukon River, advancing it sufficiently to enable an attack to be made from the north in 1911 with Rampart House as a base of operations. Topographic parties carried their work from the Yukon River across the Black River, a distance of 100 miles, and a vista was opened from its 1909 terminus 61 miles to Orange Creek.

A species of hoof-rot appeared among horses of the party early in the survey season and despite all precautions it spread, requiring the destruction of nearly one-third of the stock and weakening many of the remainder. This epidemic, combined with severe, wintry storms and damage inflicted on feed supplies by fall frosts, hindered progress from the time of the spring break-up to the fall freeze-up.

The following year 80 men and 150 horses were sent overland from Whitehorse to Carmacks, where they embarked on river steamer for Dawson. At Rampart House a miniature rodeo performance astonished local Indians who had never before seen horses. Broncho-busting by the packers, the breaking of horses to pack-saddles, caused intense wonder and admiration among the natives, the first one of whom to trust himself to the back of a plunging steed became a minor hero among his own people.[36]

A smallpox epidemic broke out at Rampart House that season but fortunately no member of the survey parties contracted the disease. The surveyors, however, had to keep away from the settlement that had been selected as a base for the season's operations. The ban resulted in a series of complications but makeshifts were made to meet the situation. Parties re-assembled in September at a point 65 miles below Rampart House. During the season topography had been carried north to Joe Creek, 40 miles from the Arctic coast. Triangulation parties finished their season's activities five miles south of the creek. During each of these annual boundary-marking expeditions Canadian and American surveyors worked so harmoniously that the impression was left on all sides that the work was being done by one large party dedicated to a common purpose.

In 1912 chiefs of the parties travelling by stage and river launch were able to reach Dawson ahead of their men and to make necessary preliminary arrangements for work in the field. This year no Indians welcomed the surveyors at Rampart House. Although the smallpox infection of the previous year had been carried, in all likelihood, from Dawson in clothing sent to the Indians as gifts, the natives held the surveyors responsible and gave them a wide berth.

Triangulation work reached the Arctic Ocean and was extended eastward along the coast about 25 miles but poor visibility prevented any connection with Herschel Island as planned. Atmospheric haziness persisted in the region and mirages were frequent. On one occasion a pack-train detoured several miles to avoid a non-existent lake. Projection of the boundary line was completed to the coast on July 18 to the accompaniment of ceremonies and the unfurling of flags. Demarcation Point, a long, narrow sandspit lacking any vegetation, proved to be between seven and eight miles west of the surveyed boundary. The boundary surveyors saw only a few Eskimos; the interest of these primitive people in the (to them) mysterious measuring activities of the white men took the form of a friendly, tolerant curiosity.

In the 1913 season the Canadian party made one of the highest climbs in the history of boundary surveys when they reached the 13,440-foot summit of Mount Natazhat, Alaska, on June 18. Howard Frederick John Lambart (1880-1946), who had obtained his Dominion land surveyor commission in November, 1907, reported that the Canadians remained "at the summit only 10 minutes, during which time they made 6 exposures with a hand camera and set a pole with a large flag. During the return journey, which took 5 hours, we were enveloped much of the time in clouds and it was intensely cold, with a heavy wind from the northeast."[37] Mount Lambart in the Yukon, in this general area, was named after this noted Canadian surveyor.

The official report of the 7th field season stated laconically that "an attempt was made to climb Mount St. Elias for the purpose of determining the intersection of the 141st Meridian with the line drawn parallel to the coast from the summit of the mountain. After ascending to an elevation of 16,500 feet, a furious storm forced the joint party to abandon the project." Actually it was a most heart-breaking experience for the daring climbers, five of whom were Americans and two Canadians. A. C. Baldwin, in charge of the party, recorded:

"By June 22 . . . our camp was now at an elevation of 7,500 feet, and to the east the western shoulder of St. Elias rose 9,000 feet in sheer height, too steep for snow to cling to. At intervals, from the dizzy heights an avalanche of snow would be seen creeping down the wrinkled sides. Seconds afterwards a dull roar would be heard, and, as the moving mass gained in proportions and speed, it swept everything before it, and reaching a precipice, would shoot out in a stream like foaming water and disappear in the depths below. Long afterwards, clouds of snow-dust hung in the air and the dull rumbling continued."

And again: "After nine hours of difficult climbing on June 29 we were within a few hundred feet of the top of the west shoulder . . . Four of the party only were feeling slightly the effects of the altitude and all were confident . . . when a storm, such as is known only at high altitudes overtook us. At first we were loath to admit that it was anything but a slight flurry and continued the ascent. It soon became evident, however, that it was to be of more than temporary duration and that even if the summit were reached, instrument work would be impossible and so . . . we reluctantly turned back."[38]

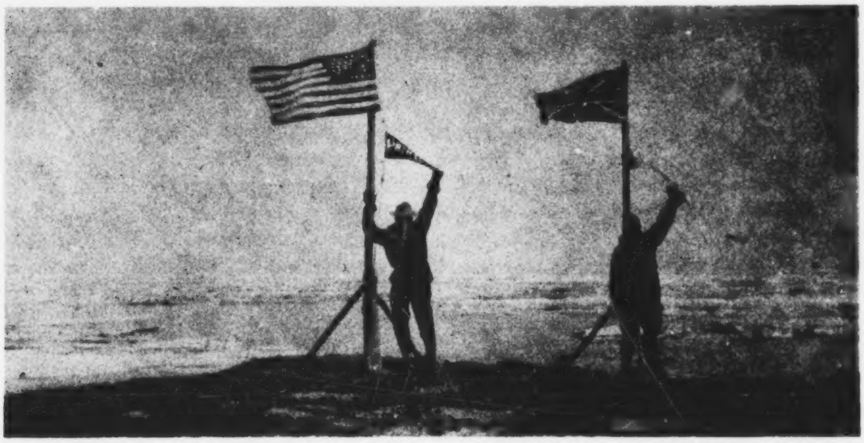


FIGURE 81. Thomas Riggs and J. D. Craig at Demarcation Point on shores of Arctic Ocean.

During that same field season a Canadian sub-party carried out a photo-topographic survey up the Logan glacier nearly 25 miles above the boundary while the topography between the glacier and Mount St. Elias was similarly obtained by a joint Canadian and United States party. The dominating presence of Mount Logan inspired hopes in these boundary surveyors, and particularly in Fred Lambart, that Canada's highest peak could soon be scaled. Twelve years later that dream was realized. Lambart of the Geodetic Survey of Canada was made deputy leader of a party of Americans and Canadians that made the first successful ascent of Mount Logan in June, 1925. Lambart had also been given the responsibility of selecting the equipment required by these mountaineers. Eight men, including three Canadians, formed the climbing group. Six of them, including Lambart, reached the summit in the early evening of June 23, 1925.[39]

Commissioners King and Tittmann declared the field work on the entire survey completed and signed their concluding report at Washington on December 17, 1913. They stated that 202 monuments "now marked the line from the Arctic Ocean to Mount St. Elias" over a distance of 645 miles, also that a vista 20 feet wide had been opened through all timber, triangulation carried north and south from the Yukon River and that a belt four miles wide had been mapped for practically the entire distance of the 141st meridian line.

The international nature of the survey made inevitable numerous crossings and recrossings of the boundary line by members of both national parties. All immigration and customs formalities were waived by both Canada and the United States in respect to these survey activities. Everything within reason was done by officials of both governments, at headquarters and on the ground, to expedite the work of the boundary survey.

Throughout these boundary surveys, lasting more than half a century and extending over 5,500 miles of international borderline, there was at all times a most commendable spirit of cooperation between surveyors of Great Britain, Canada and the United States in technical aspects of their work. The names of many who were engaged on boundary location will be familiar. Besides those who won prominence in surveying and mapping, a considerable number rose to positions of high responsibility in the public affairs of their respective countries.

11

THE DEVELOPMENT OF CANADIAN HYDROGRAPHIC SURVEYS

"And sounded all the depths and shoals . . ."
King Henry VIII, Act 3, Sc. 2

The contribution made by Admiral H. W. Bayfield, in the course of a remarkable career of surveying in Canada's fresh-water and salt-water domains, laid the foundations for a steady, if modest, growth in Canadian hydrographic services during the 50-year period following Confederation. Although this distinguished British Admiralty surveyor had left the Great Lakes in 1825, he continued surveying work in the Atlantic approaches to Canada for another 30 years. When the union of Upper and Lower Canada took place in 1841, Bayfield moved his survey headquarters from Quebec to Charlottetown. It was under that Act of Union, resulting in the formation of the Province of Canada, that a Board of Works was brought into being by the Canadian government. The Board was empowered to construct St. Lawrence River canals above Montreal where required as well as to improve and enlarge canals already in existence. The earliest recorded accounts of Canadian, as distinct from British Admiralty, hydrographic surveys are to be found in the reports and charts of provincial engineers, prepared for public works purposes. The Board of Works may be regarded, therefore, as a significant link (during a period of gradual transition) between strictly Admiralty surveys and Canadian hydrographic measuring work, particularly in bettering navigation in the St. Lawrence River system.

The story of early marine surveys on Canada's Pacific Coast would not be complete without reference to such 'Men of Admiralty' as Capt. Henry Kellett, R.N., Commander James Wood, R.N., Capt. George H. Richards, R.N., and Commander Maurice H. Smyth, R.N., and their respective vessels, H.M.S. *Herald*, H.M.S. *Pandora*, the steam sloop *Plumper* and H.M.S. *Egeria*. In 1856 Capt. Richards and Midshipman D. Pender, R.N., undertook boundary and other marine survey work in the *Plumper*, later replaced by the *Hecate*.

In 1862 Col. Moody of the Royal Engineers requested that Governor Douglas use his good offices to have Richards investigate Bute Inlet and North Bentinck Arm but Richards parried by pointing out the necessity for immediate surveys along the west coast of Vancouver Island. The captain and the colonel agreed, however, on the need for early development of a system of lights, buoyage and pilotage in British Columbia waters. In 1862 Richards requested that the Royal Engineers at New Westminster lithograph 120 copies of his new chart of Nanaimo harbor for local sale.

By 1863 Richards had completed a resurvey of Vancouver Island waters and of many of the main channels between the island and the mainland. In that same year he was recalled to England to become Hydrographer to the Royal Navy and to finish his active career as Vice-Admiral Sir George H. Richards. In his capacity of Hydrographer to the Royal Navy he never overlooked the need for marine surveys on Canada's west coast. Richards realized more than most men of his time that neither Canadian maritime trade nor colonization could flourish unless accurate hydrographic surveys were made and charts distributed to mariners.

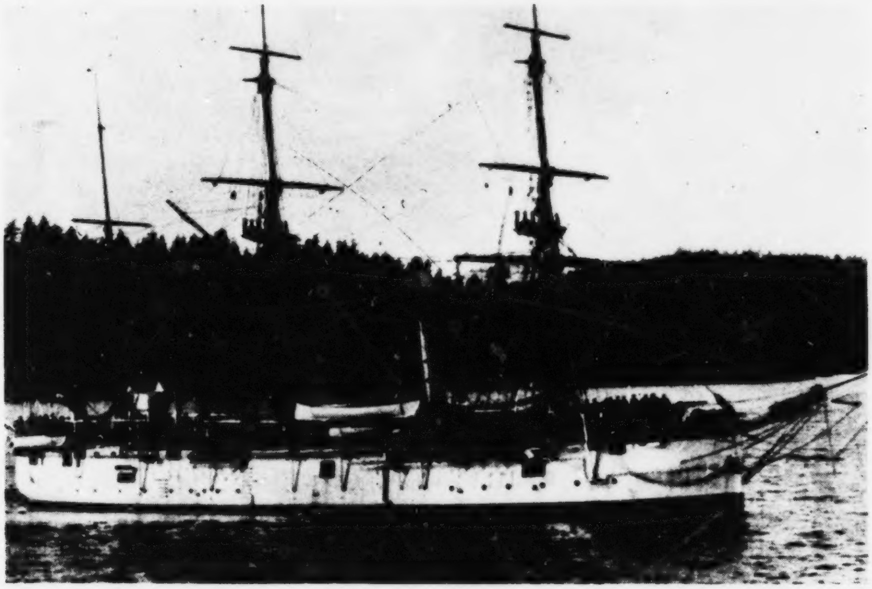


FIGURE 82. H.M.S. *Egeria*, the last ship to chart Canadian waters under Admiralty administration.

From the earliest days of exploration and settlement in Central Canada men were moved by dreams of establishing a ship canal from Georgian Bay to Montreal by way of the French and Ottawa rivers. David Taylor, David Thompson and William Hawkins were engaged on this survey, a project authorized by the Upper Canada legislature in 1837. Under the terms of an act "to provide for a Survey of the Ottawa River and Country bordering it, together with the Country and waters lying between that River and Lake Huron" the sum of £3,000 was voted to pay for the investigation.[1] David Thompson also performed hydrographic survey work for the Board of Works on Lake St. Peter (St. Lawrence River) in 1841. Some authorities regard Thompson, who had already won considerable renown as an exploratory surveyor and pioneer mapper of the North West, as one of the earliest marine surveyors in the newly-formed Province of Canada.

Twenty years after David Thompson's examination of Georgian Bay ship canal proposal, surveying activity of this nature was still in progress. In 1856 J. West made a preliminary investigation of the route then under official consideration. His work was followed by the appointment in that year by the Board of Works of the Shanly brothers, Walter and Robert, to make a survey, along with James Stewart, preliminary to the same project. These men were engaged in the field during the seasons of 1857 and 1858.[2] The whole concept, in those times, was a particularly grandiose one but its immense possibilities and formidable physical challenges attracted the interest and stirred the imaginations of men of outstanding engineering abilities. Walter Shanly and his successors, while supporting the feasibility of a navigable water link between Lake Huron and the St. Lawrence through Lake Nipissing, stressed the inadequacy of existing hydrographic information on the Georgian Bay section of the project.

In July, 1894, Parliament granted a charter to the Montreal, Ottawa and Georgian Bay Canal Company. But it was not until 1904 that the initial sum of $250,000 was voted to inaugurate, under the Minister of Public Works, a detailed official survey from the Bay to the St. Lawrence River at Montreal, a distance of 440 miles. At the outset nine survey parties were sent to the field and this force was later augmented by a hydrographic investigating party, three test-bore parties, a precise levelling party and a party assigned to Lake Nipissing and canal feeder surveys. All these varied tasks were divided among the districts of Montreal, Ottawa and Nipissing. F. H. Peters, destined to be Surveyor General of Canada and Chief, Hydrographic and Map Services, was in charge of surveying activities in the Nipissing district. E. J. Rainboth, in the early stages, had charge of similar survey work in the Ottawa district. Precise levelling on the project was supervised by C. F. X. Chaloner, who had performed geodetic levelling work for the Department of Public Works.[3]

The surveys occupied several field seasons and were conducted, at times, under conditions that were extremely trying, even hazardous. In summer the rough water and treacherous currents created some highly dangerous situations for surveyors. In winter, particularly in the season of 1904-05, high winds, drifting snow and clogged roads combined seriously to hinder progress and to cause considerable hardship for crews in the field. The fact that the surveys were completed at the cost of only two drowning accidents eloquently testified to the efficiency and care exercised by those actively involved.

Each survey party was issued with the following instruments: 2 transits with stadia, 1 Y level, 1 Dumpy level, 2 field glasses, 2 box sextants, 1 prismatic compass, 1 hand level, as well as rods, chains and sounding wires. The steel tapes used were pretested for temperature variation and tension. Meridians were established by observations of Polaris or some other circumpolar star. Shoreline stations served to unite topography with hydrography.[4]

As a result of these intensive investigations engineers in charge of the surveys reported that the ship canal could be built at an estimated cost of $100,000,000 combined with an estimated annual expenditure of nearly $1,000,000 for maintenance. When the First World War broke out this ship canal project was shelved and has not been revived beyond the stage of occasional discussion.

In 1909, on very short notice from Ottawa, A. R. Dufresne, district engineer at Winnipeg for the federal Department of Public Works, was asked to see that a reconnaissance survey was made of the Nelson River in order to determine the practicability of establishing navigation on that river between Lake Winnipeg and Hudson Bay. E. S. Miles was selected by Dufresne to conduct this survey. With one assistant and two Indian helpers the party set out by canoe from Norway House on August 28 and the survey was concluded in mid-October. Some of the mileages involved were obtained from the 1884 survey in that region made by Otto Klotz. A hand level fixed to a light tripod was used to obtain differences in water elevations at all rapids and falls; a small current meter was employed for gauging work and a box sextant for triangulation purposes. It was reported by Miles that the length of the Nelson River (430 miles) and the total lift on this route (700 feet) were close to corresponding figures for the proposed Georgian Bay Ship Canal. Miles was very guarded in his report to Dufresne, confining himself to the statement that "sufficient information has been obtained to show that any undertaking having in view the establishment of navigation on the Nelson River is one of considerable magnitude."[5]

Passage of the British North America Act in 1867 had marked, in theory if not in actual practice, the advent of hydrographic surveying in Canada under Canadian auspices. By virtue of clause 10 of Section 91 of that Act "the exclusive legislative authority of the Parliament of Canada" was extended to all matters of national import related to "Navigation and Shipping". In 1868 (31 Vic. ch. 57) the Department of Marine and Fisheries was organized to assume, at least in some degree, these new responsibilities. In 1884, for some now obscure reason, the department was provided with two deputy ministers presiding, respectively, over a Marine Department and a Fisheries Department but reporting to a single minister (47 Vic. ch. 18). This dual-deputy arrangement continued for only 8 years. In 1892, by 55-56 Vic. ch. 17, tidal observations and hydrographic surveys were assigned to a more unitary form of Marine and Fisheries. Despite this forward-looking legislative action departmental jurisdiction over hydrographic surveying and charting of Canadian waters remained unclear until early in the 20th century. Two other federal departments, namely, Public Works, and Railways and Canals, were performing similar functions. The foundering of the *Sicilian* in the St. Lawrence River below Quebec on November 24, 1902, focussed attention on the jurisdictional duplication and conflict. The mishap, without doubt, was a factor contributing to the amalgamation of hydrographic and charting work within one federal department, that of Marine and Fisheries. An Order in Council, P.C. 461, was passed on March 11, 1904, "with a view to systematizing and facilitating work in connection with Hydrographic Surveys". As a result the Department of Marine and Fisheries was accorded sole control and management of such surveys. Charts, equipment, vessels and personnel of the Public Works Department, concerned with similar functions, were transferred to Marine and Fisheries.

It should be observed at this stage that a manuscript map, produced in 1740 and now in the Public Archives of Canada, depicting the North Channel of Lake Huron, contains the results of soundings made in the entrance to Lake Superior and in St. Mary's River. The name of the draughtsman does not appear on the manuscript but it is thought to be the work of G.-J. Chaussegros de Léry. It would appear, therefore, that French military engineers can be credited with the first hydrographic surveying and mapping of these waters. It was not until nearly fifty years later, in 1788, that Captain Gother Mann, R.E., visited Lake Huron and parts of the North Channel as well as the southeastern region of Georgian Bay to map these areas with soundings.

After Bayfield's departure from the Great Lakes in 1825 and until the mid-1880s, little hydrographic surveying took place on the Canadian side of the lakes. In the early autumn of 1882, however, a tragedy of the first magnitude occurred and resulted in the inauguration of the first intensive, systematic survey of Georgian Bay under direction of Canadian authorities. On September 14 of that year the 347-ton steamer *Asia* foundered in a wild gale off Byng Inlet in Georgian Bay, about 35 miles northwest of Parry Sound. All but two of the passengers aboard were lost. Among those who died was the Ontario land surveyor Robert Sparks of Ottawa who, with a brother also lost, had intended to survey family property fronting on the Bay. They were kin of Nicholas Sparks, one of the founders of Canada's capital city. Robert's sister Mary became the wife of William Ogilvie, noted Dominion land surveyor and pioneer in the Yukon.

The ill-fated vessel, after leaving Collingwood and, later, Owen Sound the night before the storm struck, was heading for the mouth of the French River, destination of most of the passengers. No accurate port record was kept of the passenger count but it was reliably

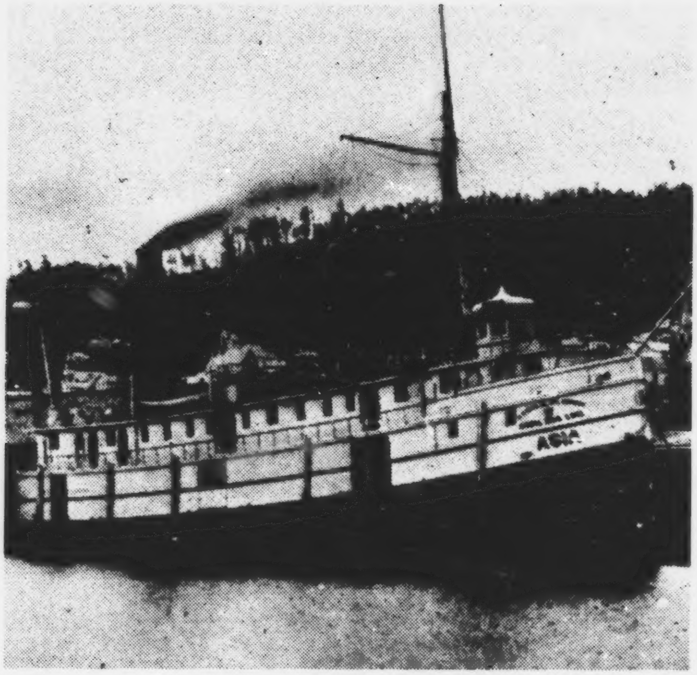


FIGURE 83. The ill-fated *Asia*.

estimated that the total number aboard the *Asia* exceeded 120. The fierce winds, accompanied by unusually high seas, hit the vessel just before noon on the 14th and within twenty minutes the *Asia* had capsized. Headlines on news stories in the Toronto *Globe* of September 26 cited "Dangers of Navigation" and "Unknown Sunken Reef Discovered". A lead editorial on the disaster in the same newspaper commented that "the foundering of the steamer *Asia* . . . is the last and worst of those terrible disasters with which we are becoming too familiar on the Northern Lakes . . . a frightful picture of the dangers which attend our inland navigation . . . ".

Collingwood, in the wake of the terrible event, was alive with grim speculation over the main cause or causes of the tragedy. There were rumors that the *Asia* was dangerously overloaded and unable, therefore, to respond properly to its helm under conditions of stress; the force of the gale, it was said, was unprecedented in that region; the 9-year vessel, it was claimed, had not been properly inspected beforehand and was actually unfit for sailing; moreover, poor judgment had been shown in taking the vessel out of port in the face of adverse barometer readings; life-saving equipment aboard had been inadequate, if not quite unusable and that an extensive, unmarked shoal or reef of rocks existed in the Bay in the vicinity of the sad occurrence.

Neither the coroner's jury verdict, as reported in the Toronto *Mail* of October 13, 1882, nor the report, now unavailable, of a special federal marine inquiry conducted by Capt. P. A. Scott, R.N., evidently placed much importance on the presence of a shoal so far as the actual foundering was concerned. What was emphasized, rather, was the calamitous effect of the other factors involved. Nevertheless the scope of the disaster and the fact that some mention had been made associating with it certain unmarked navigational hazards in the Bay, triggered prompt and decisive action at Ottawa. So much energy and celerity was shown in this regard that there is reason to wonder whether a departmental decision had been reached in the capital even before the sinking of the *Asia*, a decision to carry out at an early date a renewed marine survey of the Bay. About this time also the transcontinental (Canadian Pacific) railway was being constructed around the Bay, with the promise of a great upsurge of activity in the West and consequently heavier traffic on the Great Lakes. In addition there was a growing feeling in the country as a whole that the time had arrived for the creation and development of Canada's own hydrographic survey organization on the large inland lakes. The *Asia* incident was the dramatic, deeply shocking climax to a long series of mishaps on the Lakes. It served, as nothing else could, to fasten public and official attention on the pressing need for new charts and navigational aids, especially in Georgian Bay of Lake Huron.

One practical difficulty persisted. At the time it was quite impossible to find a Canadian sufficiently trained in hydrographic surveying to supervise the Georgian Bay project. Accordingly the Colonial Secretary in London was approached on January 3, 1883, by the Canadian High Commissioner there who pointed out that dangerous reefs in Lakes Huron and Superior required a careful survey of these waters "in view of the large and rapid increase in traffic which is now taking place." The Commissioner inquired if the British Admiralty would agree to appoint a competent hydrographer to make the survey "it being understood that the Government of the Dominion will provide at their expense the vessels and all necessary assistance which the supervising officer might request." The Admiralty agreed to this proposition.

FIGURE 84
Captain J. G. Boulton, R.N.

Bayfield's lake charts, having regard to the circumstances of his times, represented a notable accomplishment but, as Boulton later stated, "The principle I . . . adopted [was] to confine myself to present trade routes, not feeling justified in putting this country to the expense of surveying waters over which, at present, a vessel has not inducement to pass."[6]

Early in 1883 Staff Commander William Frederick Maxwell, R.N., met the Minister of Marine and Fisheries in Ottawa and discussed with him the subject of a Georgian Bay survey. He strongly recommended that Staff Commander John George Boulton (1842-1929) with whom he had been closely associated in earlier marine survey work, especially in Newfoundland and Labrador waters, be placed in charge of any such project. By mid-July Boulton had been released for this purpose by the British Admiralty and by mid-August, following a brief visit to Ottawa, he was at Georgian Bay.

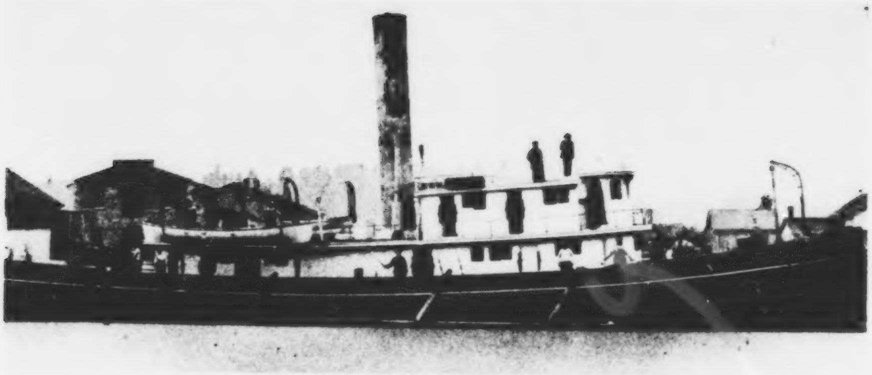


FIGURE 85. H.M.D. Survey Steamer *Bayfield.*

"The survey of Georgian Bay and the north channel of Lake Huron was taken in hand in the autumn of 1883 but having neither vessel nor assistants not much more than a reconnaissance was made at that advanced stage of the summer".[7] This comment by Boulton was much too abbreviated to convey the whole truth of the situation. While the department busily cast about for a vessel suitable for hydrographic surveying, Boulton hired tugs on a day-to-day basis in his eagerness to obtain first-hand knowledge of the dimensions of his task. Realizing that a properly-fitted ship would not be available to him prior to 1884, Boulton hired the small fishing tug *Ann Long* and began triangulation work along the northwestern shores of the Bay. Although the *Ann Long* was the first chartered vessel in the employ of what has since become the Canadian Hydrographic Service, the craft that came to be known, respectfully, as "the first *Bayfield*" must be regarded as the true pioneer among ships more or less adapted for survey work and operated under Canadian government auspices on the Great Lakes. Appropriately this trail-breaking vessel was named after Admiral H. W. Bayfield, R.N.

It was in the spring of 1884 that the department purchased the tug *Edsall* for $15,000 and then spent an additional $4,000 to equip her for marine survey functions. This refitted tug was rechristened *Bayfield* and it remained in surveying service for 19 field seasons. In 1900 it was reported to Ottawa that "for work upon the shores of the lakes now unsurveyed, principally Lake Superior, a larger, stronger and faster vessel is urgently required".[8] Accordingly, three years later, this first *Bayfield* was sold to private interests. During the period of her government commission most of the navigation routes in Canadian waters of the Great Lakes from Lake Erie to the entrance of Lake Superior were charted. A sturdy pathfinder, the *Bayfield* was more than just a response by the government of Canada to the problem of bringing about a reduction of ship losses. She was the first vessel, following Confederation, to be used for training Canadians in hydrography.

In the closing years of the 19th century sail was rapidly giving way to steam on the great waters. Fur trading was declining in importance as an economic activity in Canada's western interior. Wheat was beginning to emerge as a staple product of prairie agriculture suitable for large-scale exportation. Speedier, larger and deeper-draft vessels, plying routes never before used, began to carry cargoes from the head of the lakes to tidewater.

In March, 1884, Boulton made a decision of far-reaching importance to Canadian hydrography. He appointed as his First Assistant a youthful Ottawa-born graduate of Royal

Military College, Kingston, William James Stewart (1863-1925). Stewart was Gold Medallist and First Student of his graduating class. Destined to spend most of his career in hydrographic survey work Stewart became, in time, the first Canadian to occupy the high post of Chief Hydrographer. On May 26, 1884, the first *Bayfield* entered active survey work in Georgian Bay with Capt. Alexander M. McGregor (1828- ?) as sailing master and pilot. Charles Linter was chief engineer on the craft. This staff proved to be highly competent but even with the addition of other crew members it was a tiny force to undertake the immense task confronting them.

The area to be covered in the Bay was extensive and filled with operational hazards. Under such conditions a short survey season combined with a limited staff meant that surveys could not possibly keep pace with the demand for charts. The work was deliberate and time-consuming. Surveyors still employed lead lines dropped from the decks of the *Bayfield* or from the 6-oared open boats or dories. But Boulton somehow managed to remain hopeful. " . . . should minerals be discovered", he reported in 1885, "it will be an easy matter to extend the survey over that particular locality and with this contingency in view, the centres of the main triangulation stations have been marked by broad arrows cut into the rock, or iron bars driven into the soil."

On February 15, 1886, there was published at the Admiralty in London, England, an engraved chart, the first to be issued under orders of the Government of the Dominion of Canada. This historic chart, No. 906, was titled, "Cabot Head to Cape Smith and Entrance to Georgian Bay". In the same year the second chapter of *Georgian Bay and North Channel Pilot* was printed in Ottawa and issued by the Marine and Fisheries Department just prior to the opening of the navigation season.

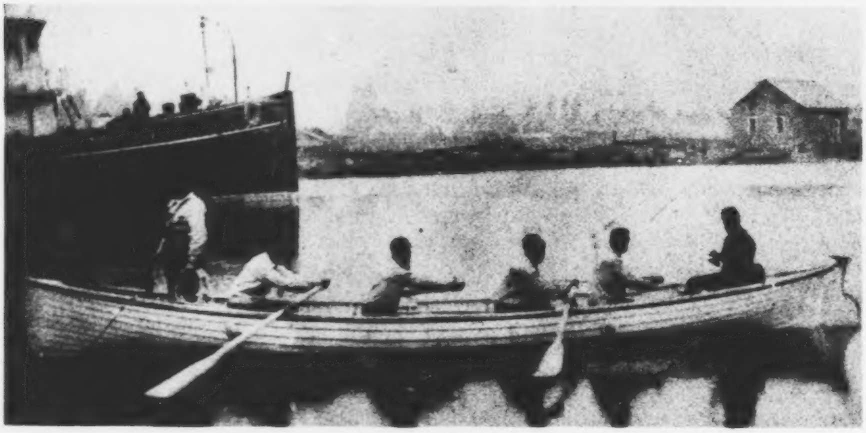


FIGURE 86. Sounding crew of the first *Bayfield*, 1884.

In June, 1890, the Canadian Pacific liner *Parthia*, outbound for the Orient, encountered a shoal in Burrard Inlet, the arm of the sea on which Vancouver is situated. This incident resulted in the dispatch of a unit from the Georgian Bay survey staff for the purpose of making a special survey of the Inlet under Stewart. Just as the first fresh-water survey under Canadian auspices had been started by Boulton, so the Burrard Inlet survey under Stewart represented not only the first hydrographic survey conducted entirely by Canadians in British Columbia waters but also the first salt-water survey to be performed under instructions of

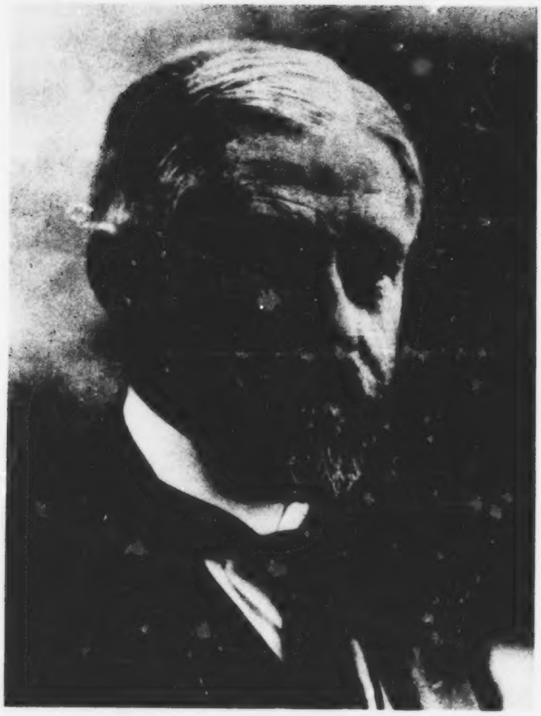


FIGURE 87
W. J. Stewart.

Canadian government authorities. This task was undertaken and completed in the summer of 1891.

In April, 1893, Staff Commander Boulton returned to England and was succeeded by Stewart as officer in charge of the Georgian Bay survey. By early summer, 1894, work in the area had been completed. In all, 11 field seasons had been required to finish the slow, exacting and monotonous labor. The total cost of these Georgian Bay and North Channel surveys was $215,000. "With the possible exception of Lake Superior", Stewart pointed out, "none of the other lakes will take anything like that amount of time or money".[9] He contrived to make the expenditure even less imposing by pointing out to Ottawa that the United States government, in completing by 1881 surveys of American shores and waters of the Great Lakes, had required 40 years and a staff three times as large as their Canadian counterpart. Moreover they had spent $2,977,000 in the process.[10]

In the light of pressing demands for reliable charts of the Great Lakes generally, Stewart was instructed by Ottawa to carry out surveys on Lake Huron for the remainder of the 1894 season. In his report on that year's progress Stewart observed, "The south shore of Grand Manitoulin Island was found to be very low, much broken up and densely wooded almost to the water's edge, trending so nearly to a straight line that an ordinary triangulation was out of the question. I therefore constructed a number of 3-cornered platform buoys to support small and light pyramids. These were moored off-shore as far as could be conveniently seen from the low shores, and in this way a very satisfactory series of triangles were carried on, connecting Cove Island lighthouse to the Duck Islands . . . ". Stewart also reported that

FIGURE 88
Frederick Anderson.

the survey of Georgian Bay was practically finished and indicated there was only a relatively small area in the middle of the Bay that had not been systematically sounded.

Before the opening of the 1895 season it was decided that priority in surveying would be given the north shore of Lake Erie "both because the quantity of traffic in the lake is important and the coast dangerous, and because the completion of the survey is a preliminary necessity of the international boundary line." This was but the first of many subsequent occasions on which services of Canadian hydrographers would be required in connection with international boundary line location.

In 1901 Stewart turned over the Lake Huron survey to Frederick Anderson (1869-1957) and proceeded to Lake Winnipeg to carry out the initial hydrographic survey of that body of water. In order to save time and money the Geological Survey of Canada map of the lake was used as a base sheet for the new chart. Published in Ottawa in 1903 this was the first photo-lithographed chart made by Canadians and printed in this country.

In December, 1901, the 276-ton steam tug *Lord Stanley*, purchased by the department for $50,000, replaced the first *Bayfield*. On its way to the Upper Lakes the *Lord Stanley* met with a mishap at Toronto. The resulting need for repairs brought about a postponement of her departure for Lake Superior until the beginning of the 1903 field season. At this time, much against his well-articulated wishes, that grizzled veteran of the lakes, Capt. McGregor, was retired at the age of 75. The *Lord Stanley* was rechristened and became known as the second *Bayfield* with Capt. A. O. Zealand as her sailing master. She remained on the Great Lakes until the end of the 1920 season. With the completion of surveys in Lake Superior that autumn the second *Bayfield* was transferred to the Gulf of St. Lawrence Survey. During most of the 1920s this vessel was employed on rather spasmodic survey service in Northumberland Strait and in the vicinity of the Magdalen Islands. Not counting her years with the

National Revenue Department and with the Navy, nor the seasons during which she underwent repairs, the second *Bayfield* had been engaged on active surveying duties during 20 field seasons. In that period the waters from the Gulf of St. Lawrence to the head of the lakes were recharted. This splendid record of marine survey service was worthy of the name she carried so proudly.

Three years after the completion of the first of the Canadian hydrographic surveys of any of the Great Lakes, Stewart reported on the preparation and publication of a second edition of the *Georgian Bay and North Channel Pilot*. Two years later, in his 1899 report, he commented that "the demand for the last edition (300 copies) had been so great that it had been cleared out." The 1899 edition was reprinted in Ottawa in the following year. Four years later a new, complete edition of this *Pilot* appeared in print.

Sailing Directions, allied with charts, well deserve the appellation "road maps of the seas". *Sailing Directions* is an expression generally synonymous with the term *Pilot* when applied to an official publication designed to provide guidance for mariners supplementary to information borne on nautical charts. The British, traditionally, and Canadians, in more recent years, make use of the term *Pilot* but Americans tend to employ the description *Sailing Directions*. The British Admiralty began to publish such directions about 1825. In 1846 Bayfield's book was titled, *Sailing Directions for the Gulf and River St. Lawrence*.

Another term frequently heard in the language of marine charting was that of *fair sheet*. In recent times, however, this expression has given place to the description *compilation sheet*. In days when hand work played a prominent part in the production of charts a fair sheet represented the final draft or manuscript chart before submission to engravers and printers. This final draft was based upon a field or rough sheet and was, in fact, a drawing compiled from information contained on the field sheet.

The marine survey of Lake Erie between Point Pelee and Port Colborne, costing $38,608.95, requiring two seasons and a part of a third to complete, was finished in 1897. As an early example of international inter-dependence Stewart reported in 1896 that " . . . the balance of the Canadian shore [of Lake Erie] was surveyed by the United States government about 20 years ago and as no complaints have been made . . . there seems no necessity for a resurvey."

In 1896-97 two fair sheets of the Canadian coast of Lake Erie were prepared. One was sent to the Hydrographer to the Royal Navy "who had all our charts engraved free of charge" and one to the Hydrographer to the United States Navy. After 1898, when survey work was resumed on Lake Huron, the title of the Canadian organization was changed from Georgian Bay Survey to Great Lakes Survey. Even at that relatively advanced stage of development the Canadian hydrographic staff numbered six men in addition to Stewart, three of whom were hydrographers. Only one vessel, the second *Bayfield*, was available for such tasks.

Following Confederation responsibility for hydrographic surveys on its inland waters was assumed by Canada. The British Admiralty continued its surveys on the Atlantic and Pacific coasts of this country. Canada, in nearly every case, paid half of the costs involved in prosecuting these efforts. In the early years of the 20th century, however, Great Britain was confronted by a new situation in the realm of sea power, namely, an ominous growth in the naval strength and potential of a dynamic Germany. Mindful of this latent threat to her national security Britain decided to curtail her widespread marine survey operations. In May, 1904, the Admiralty formally requested that Canada assume full responsibility for hydrographic surveying of her own sea coasts. In January, 1905, the Governor General, Earl Grey, forwarded from Ottawa to the Colonial Secretary in London a minute of the Canadian Privy Council "expressing concurrence in the desirability of Canada's undertaking the marine surveys of her own sea coasts" but requesting "that until arrangements for giving assent to

FIGURE 89
P. C. Musgrave, R.N.

FIGURE 90. H. D. Parizeau.

this plan are completed . . . the Admiralty will allow their surveying vessels on those coasts to continue their work there." To this proposal the Admiralty replied affirmatively.

With the exception of some hydrographic work by the Public Works Department, no systematic Canadian marine surveys had been carried out in the lower St. Lawrence until Stewart arrived on the scene in 1905. For this project he was able to obtain the loan of the *Gulnare*. A succession of survey vessels bore that name, after the example of the *Bayfield* line. The ship loaned to Stewart was the last of the name *Gulnare* to operate under Admiralty auspices in Newfoundland waters, prior to the appearance there of a newer and more seaworthy vessel, the English steam yacht *Ellinor*. Following its replacement the *Gulnare* was employed in the Gulf of St. Lawrence by the Tidal Survey of Canada, embarking on this work in the season of 1902. It was from the Tidal Survey organization that Stewart, three years later, was able to borrow this gallant but aging craft.

It has been noted that the consolidation of 1904 brought nearly all Canadian government marine survey activities under the Marine and Fisheries Department. Under the terms of Order in Council P.C. 1200, dated August 2nd of that year Stewart was appointed Chief Hydrographic Surveyor. In practice, however, he preferred to use the shorter title, Chief Hydrographer. Stewart was not slow to realize that with the merging of survey services he had under his command not only more men and equipment with which to carry out projects, he had the nucleus of what could well become a survey organization of truly national significance and proportions.

Two years later the first continuing marine survey, under Canadian auspices, commenced on Canada's Pacific Coast. George Blanchard Dodge was released from the staff of Surveyor General Deville to supervise the early stages of this ambitious project. Prior to his arrival in Ottawa, Dodge had seen service with Admiralty surveys in Newfoundland waters. In the spring of 1907 Mr. P. C. Musgrave, late Lieutenant Royal Navy, who had joined the Hydrographic Survey of Canada, was appointed to succeed Dodge. Under Musgrave's energetic direction the approaches to the port of Prince Rupert were examined and a preliminary photo-lithographed chart of the work was issued prior to the opening of the following navigation season. In those days of highly ambitious railway construction the Grand Trunk Pacific's transcontinental line was being pushed westward with considerable speed. Sites for the most suitable Pacific terminus of the railway in the general area of the Portland Canal entrance were being investigated. Port Simpson, in fact, was intended originally to serve the railway in this role and initial surveys under the British Admiralty took place in that vicinity. But, in the end, the port of Prince Rupert was finally selected.

In hydrographic surveys near Prince Rupert, Dodge, and subsequently Musgrave, had as assistant Montreal-born Henri D. Parizeau (1877-1954). Parizeau had joined the federal Department of Public Works in May, 1901. Later that season he was, in effect, assistant to the resident engineer in the Lower St. Lawrence River and joined a party engaged in precise levelling work in that area. He first encountered hydrographic field work in the Thousand Islands area in 1903. When the departmental amalgamation took place in the following year Parizeau was absorbed into the Marine and Fisheries organization and was promoted to senior assistant, Upper St. Lawrence River. In 1906 he volunteered to assist in urgently required marine surveys on the Pacific Coast. He remained on this work during four seasons, returning to Central Canada after that spell of duty. Parizeau, however, was destined to serve for many more years on the Pacific Coast in hydrographic survey activity. In 1912 he began a survey of James Bay and in 1913 he was placed in charge of Great Lakes surveys but in 1920, on the death of Musgrave, Parizeau was again on Canada's West Coast as Musgrave's successor in charge of marine surveys there. From 1920 to 1937 Parizeau never missed a season's work in the arduous performance of his command.

Musgrave invariably showed great respect for the formalities and ritual of naval life. When he was in charge of a survey vessel, formal dress was required of those attending dinner aboard. Parizeau, in contrast, was rather free and easy in these matters. Musgrave, Parizeau and L. R. Davies, in retrospect, appear as the true founders and early developers of Canadian hydrographic surveys on the coasts of British Columbia.

Parizeau could tell a story with great flair and he delighted listeners on many occasions with his yarn about early soundings in the South Atlantic. In 1845, Capt. Kellett, in command of H.M.S. *Herald* left England bound for the North Pacific Coast of Canada. His sailing vessel, en route, was becalmed in the South Atlantic and, according to Parizeau, Kellett decided to put the delay to good purpose by taking deep sea soundings. Splicing together several thousand feet of spun yarn his men wound this on a reel. The line, weighted with a 200-pound piece of cast iron, was paid out until the reel stopped turning at 2,940 fathoms (17,640 feet). To check on the accuracy of the operation a second sounding was made. Each of these two soundings consumed four hours. As Parizeau would point out to his hearers the depth of water, using echo sounding devices of 100 years later, could have been determined with even greater accuracy in the space of a few minutes.[11]

In regard to pioneer marine surveys in Canada's Pacific waters special mention ought to be made of H.M.S. *Egeria*. From 1898 to 1910, under instructions from the British Admiralty, this vessel was employed on various surveys under a succession of commanders. In 1898, for instance, Commander M. H. Smyth, R.N., began triangulation work in the Juan de Fuca Strait and in the Strait of Georgia as a preliminary operation in connection with a resurvey of ship channels between Vancouver Island and the mainland. Smyth was succeeded, in the command of the *Egeria*, first by Commander C. H. Simpson, then Commander J. F. Parry, followed by Capt. F. C. Learmouth, Capt. J. E. Parry and Lieut.-Commander J. D. Nares, all of the Royal Navy. On December 8, 1910, the *Egeria*, according to Admiralty records, was paid off and recommissioned the following day with a reduced complement, to prepare the ship for sale after April 1, 1911. Thus ended Admiralty charting in British Columbia waters, activity that had commenced a century and a quarter earlier under Captains Cook and Vancouver.

> Take note of their departure
> and salute their fame.
> By dedication to demands
> of duty and precision
> these Men of Admiralty,
> made safer and more usable
> the mighty waters, green and indigo,
> that wash the shores and serve the needs
> of Canada.

Charts produced as a result of surveys performed by H.M.S. *Egeria* greatly assisted vessels active in the lumbering and fishing industries of British Columbia and contributed in a marked degree to the safe and expeditious transportation of passengers and freight to ports serving the Yukon Territory during the Klondike Gold Rush.

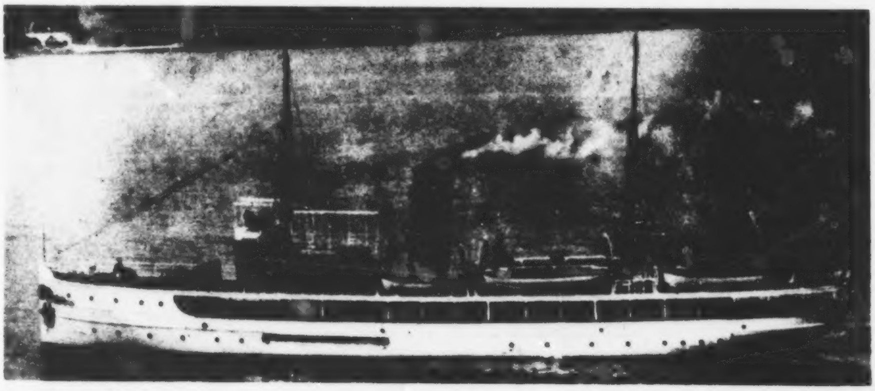


FIGURE 91. C.G.S. *Lillooet*, first survey vessel designed and built in Canada (at Esquimalt) for Canadian hydrographic survey work.

In addition to the *Bayfield* and *Gulnare*, other survey ships employed in Canadian hydrographic work prior to the First World War included *La Canadienne*, a vessel made available by the Department of Marine and Fisheries to Lieut. I. B. Miles, R.N., in 1906 for work in the Lower St. Lawrence. Four years later the *Cartier*, built in Scotland, replaced *La Canadienne*, and remained in service until 1947. The *Acadia*, which began survey tasks in Atlantic waters in 1913 was the first Canadian survey ship to have its structure reinforced for work in ice. The *Lillooet* was the first survey ship designed and built for Canadian hydrographic surveys. It was constructed at Esquimalt and commissioned in 1908 for surveys on the Pacific Coast. The *Lillooet* commenced her career near Prince Rupert in June of that year, continuing operations in that vicinity during the two following field seasons. In 1911 she was in the Ocean Falls area, working in conjunction with a shore party under Davies in the Queen Charlotte Islands. For a quarter-century CGS *Lillooet* was closely identified with marine surveys on the Pacific Coast of Canada, and in 1916 ended her days. In 1917 the vessels *Acadia*, *Cartier* and *Bayfield* were taken over by the Royal Canadian Navy.

Early in the 20th century public interest in Canada's western interior became increasingly focussed on prospects for the establishment of an ocean port in Manitoba on Hudson Bay,

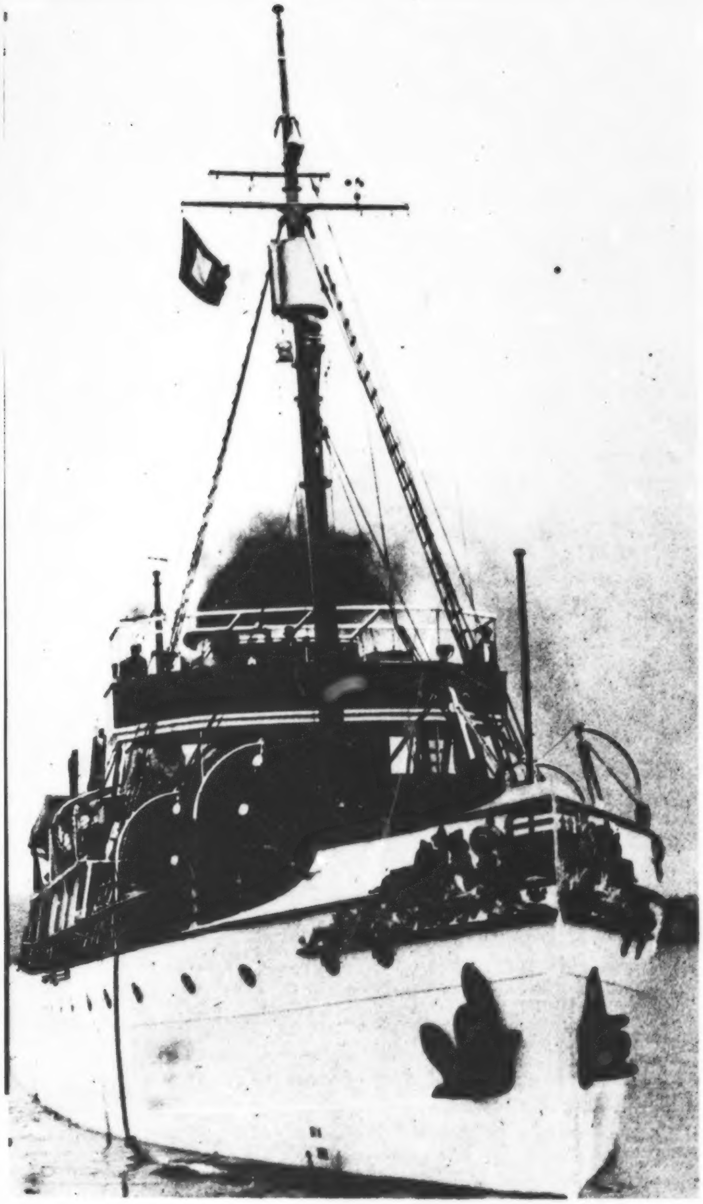
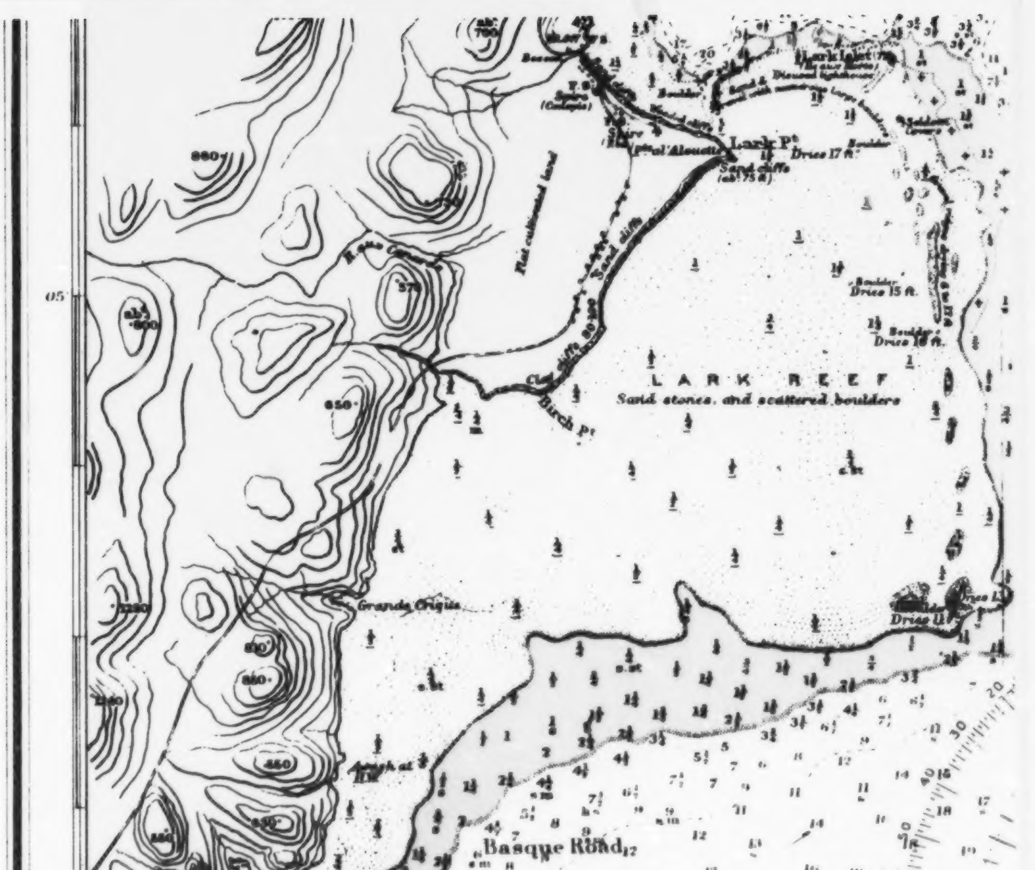


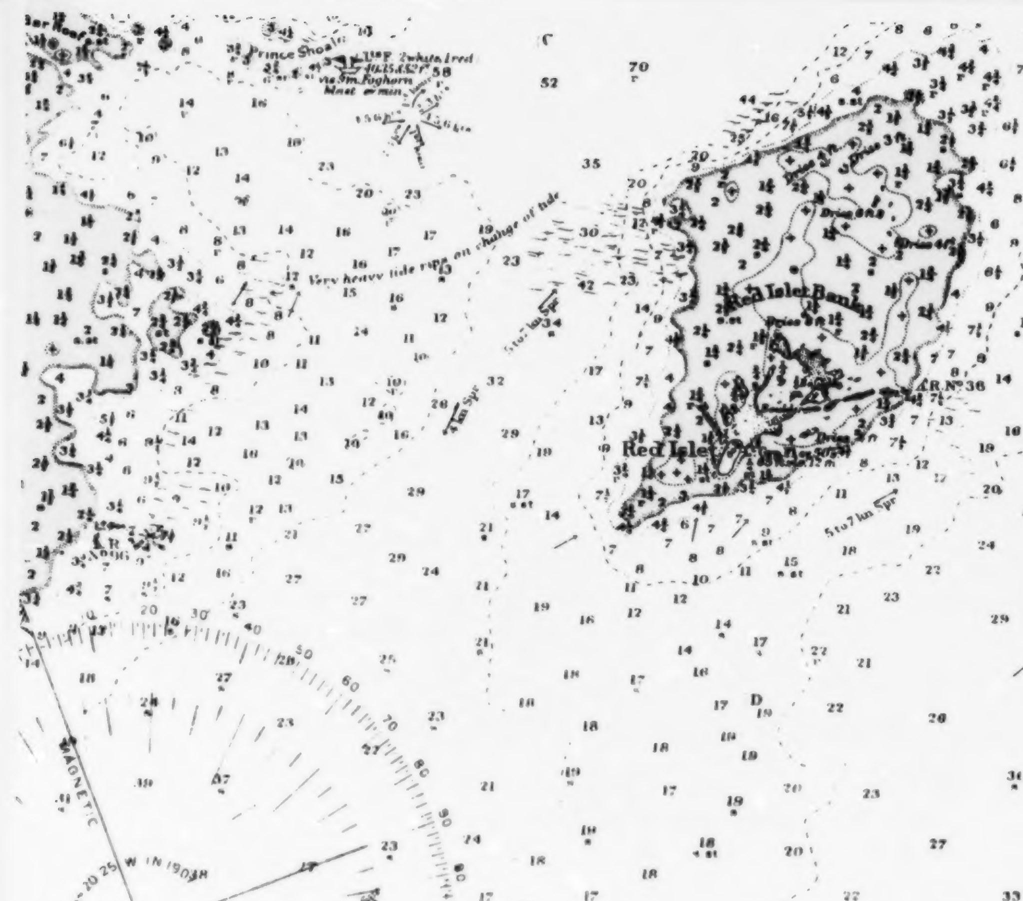
FIGURE 92.
C.G.S. *Acadia*, the first northern survey vessel of the Canadian Hydrographic Service.

mainly because of the facilities it would provide in expediting the export of prairie grain to Europe as well as in reducing transportation costs involved. Both Churchill and Nelson, at the mouths of rivers bearing these names, were being considered at the time as port sites. In order to assemble reliable information on the relative advantages of the two harbors, a survey expedition was sent by Ottawa to Hudson Bay in 1910. The launch party that was instructed to investigate possibilities at Churchill consisted of G. A. Bachand and Charles Savary; the Nelson party, of H. D. Parizeau and R. J. Fraser. Both survey parties were under the direction of Lieut. I. B. Miles, R.N., who was Admiralty Surveyor, H.M.S. *Egeria*,



Lark Pt
Sand cliffs
Flat cultivated land
LARK REEF
Sand, stones, and scattered boulders
Birch Pt
Basque Road
Boulder Dries 15 ft.
Dries 17 ft.
05'
48°
58'
69°48'
45'
40
CANADA
ST LAWRENCE RIVER
(BELOW QUEBEC)
RAZADE ISLANDS TO WHITE ISLAN
Surveyed by
Lieut. I.B. Miles, R.N. 1907 08
Assisted by
Messrs C. Savary, G.C. Venn and W.R. Mc Gee.
under the orders of
Honourable Louis P. Brodeur, Minister of the Naval Service of Canada.
SOUNDINGS IN FATHOMS.
The datum to which soundings are reduced i.e the Low Water at Ordinary Spring Tides is 19·2 feet below a bench mark cut in the vertical face of the cliff on the north side of the small point in l'Anse a l'Eau from which the pier projects. At Trois Pistoles the corresponding datum is 16·8 feet below a straight line cut on a small pointed rock on the high line just west of the inner end of the pier or 19 feet below the summit of this rock.

MAP 13. Portion of the 1907-08 hydrographic chart of the
East Coast charts produced by the Canadian Hydr


Prince Shoal
Very heavy tide rips on change of tide
Red Islet Bank
Red Islet
MAGNETIC
VAR. 20 25' W IN 1908
NEARLY STATIONARY
WHITE I. REEF
Submarine fog bell
Heavy tide rips on change of tide
SOUTH CHANNEL
35'

wrence River below Quebec City. One of the first engraved
hic Survey (Service). Published, 1911.

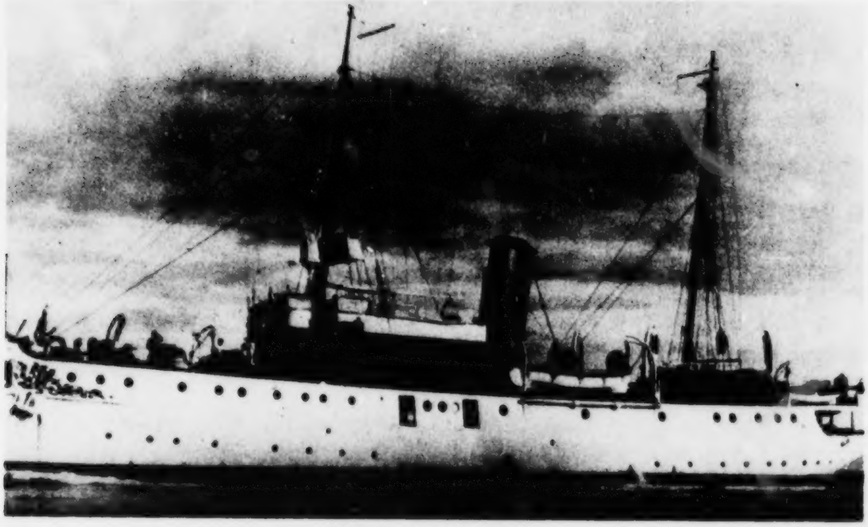


FIGURE 93. C.G.S. *Cartier.*

until 1905 on the Pacific Coast. In 1906 Miles had replaced Stewart as officer in charge of the Gulf and River St. Lawrence survey. Members of the Hudson Bay expedition under Miles reached their respective destinations aboard the government ice-breaker *Stanley.*

The Tidal and Current Survey

As early as 1891 Boulton had recommended that 'datum stones' be placed in the Great Lakes for the provision of more accurate information on water levels than that forthcoming from the fickle memory of the oldest inhabitant. By 1912 the Public Works Department had installed several automatic gauges in the St. Lawrence River and the Great Lakes in order to record water levels systematically. In May of that year these gauges were transferred to the Hydrographic Survey and placed under the supervision of William J. Stewart, Chief Hydrographer. Five years previously Stewart had been appointed a Commissioner of the International Waterways Commission. From its activities useful water-level data were obtained in regard to the St. Lawrence and the Great Lakes. Some of this information was employed to great advantage, along with the results of a series of current survey measurements, to improve navigation in the St. Lawrence River to Montreal prior to the First World War.

In the course of time the Canadian Hydrographic Service, as it came to be titled, acquired responsibility for all hydrographic, tidal and inland water level surveys throughout Canada. At the outset, as has been noted, the task of making tidal observations on Canada's coasts had been allotted by statute to the Department of Marine and Fisheries. Nevertheless for years mariners using the River and Gulf of St. Lawrence were handicapped by what they considered to be a lack of authoritative data on the behavior of currents in those waters. Rightly or wrongly, to this alleged shortfall of information was commonly attributed the alarming number of shipwrecks that had occurred in that area in the 1880s. In 1884 the British Association of Montreal passed a resolution advocating that tidal studies be undertaken by a federal government agency. Again, two years later, a deputation from that association and from the Royal Society of Canada made a forceful presentation on this issue to the Prime Minister and to the Minister of Marine and Fisheries. Little official action was taken at this stage, however, likely because of the relatively expensive commitments already made by Ottawa in regard to surveys of Georgian Bay and of Hudson Strait. In 1888 the two organizations again combined to petition Ottawa, supported on this occasion by the signatures of nearly 400 captains and ships' officers. In the petition it was pointed out that by means of the improvements recommended "serious loss of life and property due to shipwrecks attributable to unknown currents during fogs and hazy weather may thus be greatly diminished."

After periods of patience-testing inactivity, things began to happen. By the end of 1893 the government had moved to install a few automatic tide gauges on the Atlantic Coast. Temporarily the system was placed under the supervision of Charles Carpmael, Director of Meteorological Service at Toronto, with Andrew R. Gordon as Assistant Supervisor. In that same year William Bell Dawson (1854-1944) was appointed head of the newly-formed service authorized to make tidal and current surveys. He was a younger brother of George Mercer Dawson of the Geological Survey of Canada and had studied engineering in Paris following graduation from McGill. From 1878 to 1893 W. Bell Dawson had been active in Canada as a land surveyor and engineer. In his new role he signed as 'Engineer in charge of the Tidal Survey' and as such he proceeded to draft a master plan designed to provide this country with information on tides and currents equal in scope and reliability to that possessed

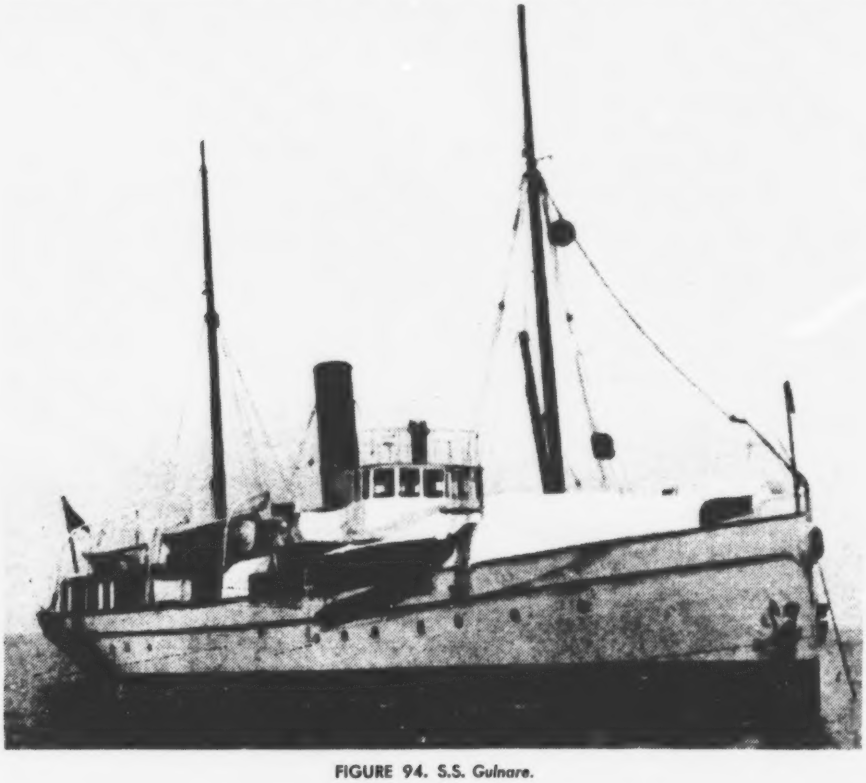
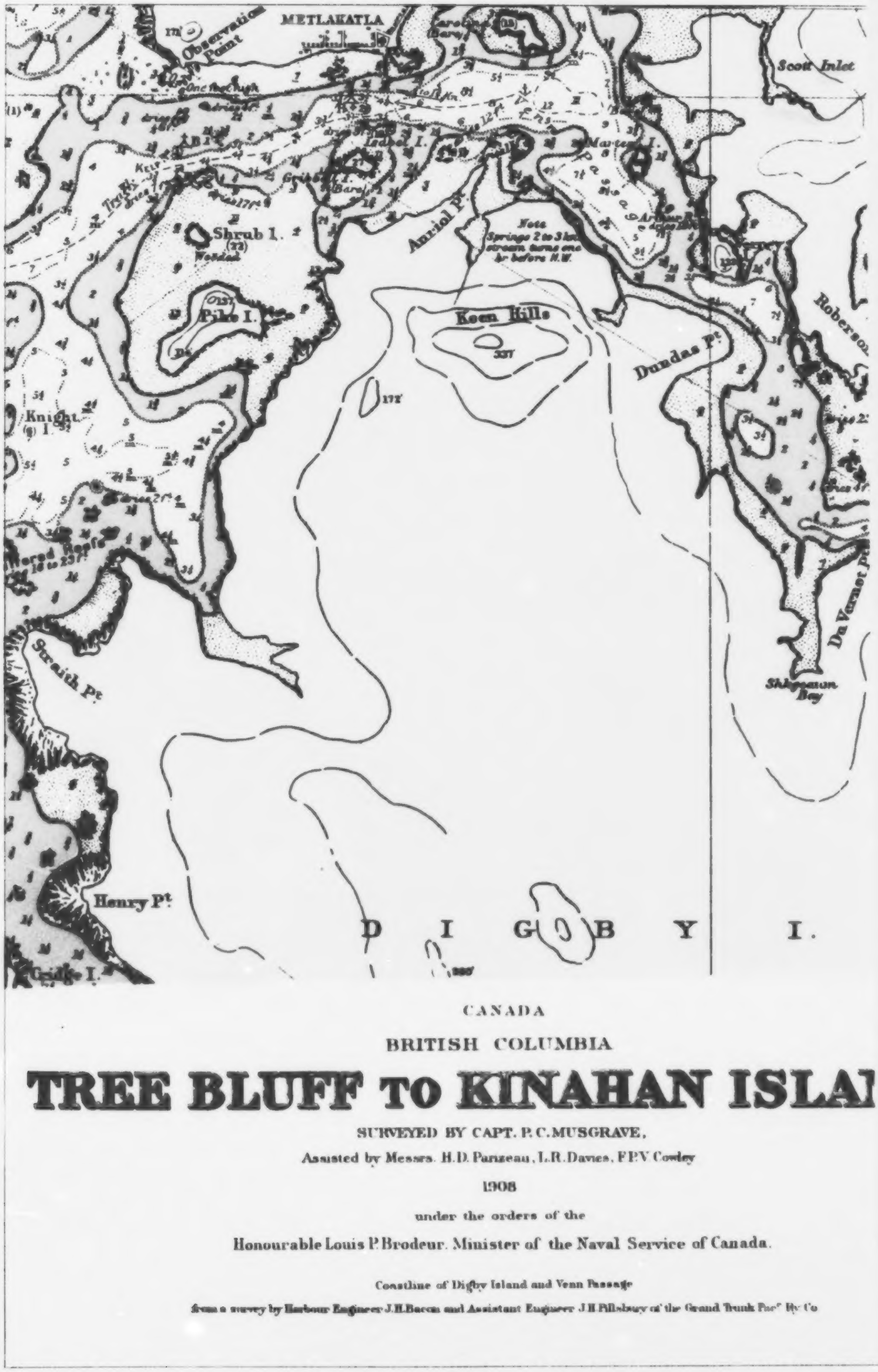
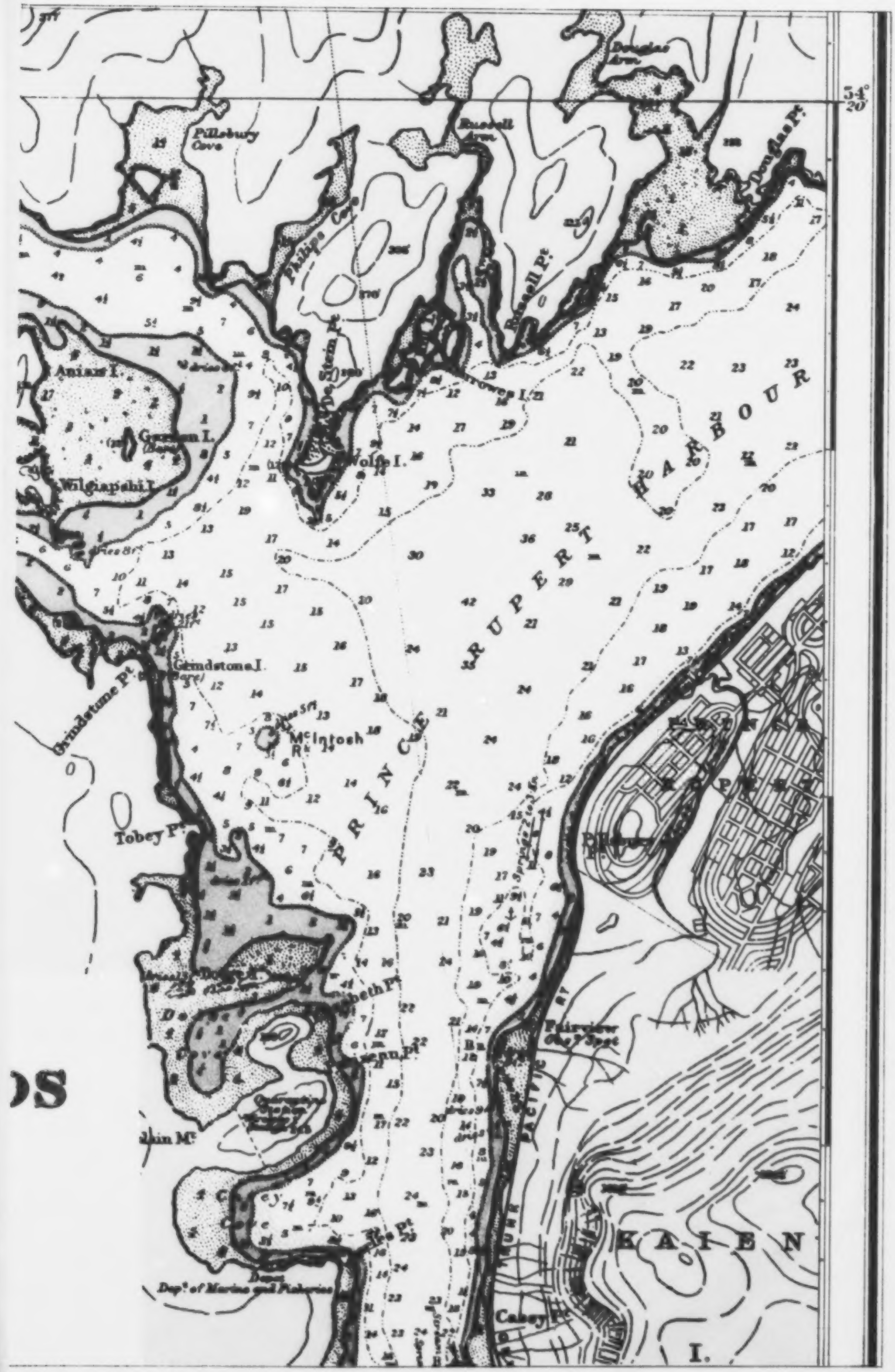


FIGURE 94. S.S. *Gulnare.*


METLAKATLA
Observation Point
Scott Inlet
Shrub I.
Pike I.
Keen Hills
Anniol Pt
Note
Springs 2 to 3 kts
stream turns one
hr before H.W.
Dundas Pt
Roberson
Knight I.
Straith Pt
Henry Pt
Gridge I.
Shkgeaun
Bay
Du Vernet Pt
D I G B Y I.
CANADA
BRITISH COLUMBIA
TREE BLUFF TO KINAHAN ISLA
SURVEYED BY CAPT. P. C. MUSGRAVE,
Assisted by Messrs. H. D. Parizeau, L. R. Davies, F. P. V. Cowley
1908
under the orders of the
Honourable Louis P. Brodeur, Minister of the Naval Service of Canada.
Coastline of Digby Island and Venn Passage
from a survey by Harbour Engineer J. H. Bacon and Assistant Engineer J. H. Pillsbury of the Grand Trunk Pac. Ry. Co

MAP 14. Portion of the 1908 hydrographic chart of Princ
West Coast charts produced by the Canadian



OS
Pillsbury Cove
Phillips Cove
Russell Arm
Douglas Arm
Russell Pt.
Douglas Pt.
Anian I.
Wilgiapshi I.
Wolfe I.
Grindstone I.
Grindstone Pt.
McIntosh Rk.
Tobey Pt.
Fairview
Casey Pt.
Dep.t of Marine and Fisheries
R U P E R T
H A R B O U R
P R I N C E
P R I N C E R U P E R T
K A I E N
I.
54°
20'

pert Harbour and approaches. One of the first engraved
ographic Survey (Service). Published, 1911.

by the world's leading seafaring nations. He asked for $29,000 from the federal treasury to help finance field operations in the season of 1894 but had to be content with a vote of only a third of that amount. But the financial strain was eased somewhat for him by the loan for his work during that season of the government vessel *Lansdowne*. This gratifying development enabled Dawson to perform surveys of ocean currents in the Strait of Belle Isle and in Cabot Strait, the first examination of the kind to be made by a Canadian working under authorization from Ottawa. By the end of the century permanent tide gauges were in operation at Quebec City, Father Point, Strait of Belle Isle, St. Paul Island, Saint John, Halifax and Yarmouth. In 1902 *Gulnare*, tidal survey, replaced *Lansdowne* in the Gulf.

Dawson, in his time, had to contend against shortages in manpower, money, vessels and equipment. The translation of tidal records into tidal predictions was beyond the resources of his small staff to handle. The data they collected were transmitted regularly to Liverpool Observatory and Tidal Institute for any required processing. But by the time of Dawson's retirement in 1924 he could look back over 30 years of steady, if not spectacular, progress in this aspect of hydrographic surveying as well as upon a gradual lessening of Canadian dependence upon British scientific know-how and facilities in applying tidal survey information to the solution of practical problems of navigation in Canadian waters.

Canadian Oceanography

The collection of oceanographical information in Canadian waters, under Canadian auspices, began to occur at least as early as Boulton's activities in Georgian Bay. Data of this nature acquired by him, consisted of air and water temperatures, salinities, bottom samples for analysis and water levels. In regard to the 1885 season, for example, Boulton reported that "on the 2nd of August, having to cross the bay from the vicinity of Byng Inlet to Owen Sound to replenish with coal, advantage was taken of this opportunity to carry a line of soundings across . . . The principal object was to ascertain the bottom and surface temperatures . . . Specimens of the bottom were brought up and handed to the Acting Director of the Geological Survey for examination."[12]

In 1915 the Hydrographic Survey of Canada organized and carried out its first oceanographic cruise in the Atlantic, including the Northumberland and Cabot straits as well as waters of the Gulf Stream. CGS (Canadian Government Ship) *Acadia*, with Capt. F. Anderson in charge, completed cruises between Halifax and Newfoundland under the direction of Dr. Hjort, Director of Norwegian Fisheries. These were followed by a similar cruise for Dr. Hjort. Its purpose was to obtain off-shore soundings as part of an oceanographical study bearing on the long-term outlook for Canadian fisheries in that part of the Atlantic Ocean.[13]

The last season of hydrographic surveying by the British Admiralty in Newfoundland waters prior to the First World War was in 1912. The *Ellinor*, in need of repairs, was not ready for surveying until August of that season. In the waiting period Capt. Combe and civilian assistants resurveyed St. John's harbor and its approaches. In the Admiralty Report of 1912 it was stated that "large areas were examined by means of a wire-sweep worked by the boats, and several new shoals were discovered."

By 1914-15 the Hydrographic Survey of Canada had come a long way from those days when, on Georgian Bay, operations were conducted by a tiny, hard-pressed staff using lead-lines tossed from a refitted tug boat, from sailing gigs or from open dories. In the intervening years the hydrographic fleet had grown to six* registered ships, several chartered craft and a number of survey launches. The staff had increased to include not only hydrographers and water-level surveyors but as well mathematicians, cartographic draughtsmen and compilers. The whole program had become closely allied with the more energetic assertion by Canada of its sovereignty over remote and isolated parts of its far-flung domain, as well as with the economic development of the country as a whole. When it is borne in mind that Canada has a coastline of more than 100,000 nautical miles, probably the longest of any country in the world, and that it borders three oceans, results accomplished in terms of hydrographic surveys performed, nautical charts compiled and constructed, tide and current tables issued as well as *Pilots* and *Sailing Directions* published, form an impressive and exciting record. These achievements were made possible only by the pioneering zeal, skill and endurance of men such as Bayfield, Boulton, Musgrave and Miles of the British Admiralty, and by such Canadian-born hydrographers as Stewart, Anderson, Parizeau and Charles Savary, as well as Dawson of the Tidal and Current Survey.

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*Actually seven, but one was lost in James Bay in 1913.

12

THE GEODETIC SURVEY OF CANADA: THE FIRST DECADE

"Bless the mark . . ."
Two Gentlemen of Verona, Act 4, Sc. 4

In retrospect it is not easy to understand why so many difficulties and delays attended the creation of a federal government goedetic survey organization. Nearly a quarter of a century elapsed from the time the first approach was made to Ottawa authorities, advocating such an establishment, until it was brought formally into being in 1909. The intervening years were filled with extensive correspondence on this project, supplemented by reports, resolutions, petitions and other representations from scientific bodies and learned societies, all pressing vigorously for the inauguration of geodetic surveying on a national, systematic basis in Canada.

Undoubtedly the Laurier government and its immediate predecessors in office at Ottawa had been subjected to intensive pressures to institute or expand federal services in a variety of fields. During these years dynamic forces were at work influencing and shaping the future of Canada. The extent and direction of western settlement took shape as considerable numbers of people left their homes in the older-established parts of the nation for the plains and parklands west of Winnipeg. Mining and lumbering areas in northern Ontario and Quebec also experienced a marked influx of settlers.

This transference of population within Canada, along with a steady flow of immigrants from Europe and the United States, was followed by a period of acute economic strains, political unrest and of changing political alignments. In his tour of the West in the summer of 1910 the Prime Minister, Sir Wilfrid Laurier, found that tariff protectionism, as a national fiscal policy, was fast losing support in that part of the country. Sir Wilfrid had been present as a national godfather at the historic ceremonies at Regina and Edmonton marking the creation of the new provinces of Saskatchewan and Alberta in 1905. Now, within five years, he discovered that the newcomers he had saluted so eloquently at the twin birthday parties had become deeply discontented with their lot. Freer trade with the United States was demanded by strident and persistent voices. As Sir Wilfrid pondered over these portentous developments he came to regard reciprocity in trade between Canada and the United States as a logical remedy for the economic ills then afflicting both nations. But in its subsequent promotion of a reciprocity arrangement and in the general election that followed, the Liberal government and party failed to win the support of a majority of Canadians. In September, 1911, Sir Robert Borden swept triumphantly to power in Ottawa, the first Conservative prime minister in 15 years. The solemn, deep-voiced Nova Scotian had succeeded the distinguished-looking, gracious-mannered Sir Wilfrid to the leadership of a nation in flux.

In the closing years of the 19th century the terms 'trigonometrical', 'triangulation' and 'geodetic' were generally employed as interchangeable descriptions of a basic type of surveying. In essence each term, as then used, meant the establishment of accurate points scattered across a given area and, taken together, forming a geometrical framework within which hills, lakes, valleys, rivers and islands and other natural features could be depicted in their true relationship on a topographic map. Data for placing parallels of latitude and meridians of longitude in their true alignment with reference to existing cadastral and other surveys could be determined only through what has since become known as a geodetic survey.

Geodetic work, based on the science of geodesy, the study of the size and shape of the earth and of its gravitational field, is regarded as the backbone; the strong, reliable and supporting framework of the entire superstructure of all surveys and map making. Just as a durable private home requires a solid foundation, as well as a central heating plant to serve the differing temperature needs of its assortment of rooms, so primary geodetic controls, including precise levelling, form the firm basis on which depends the accuracy of topographic, hydrographic, military and other surveys as well as the reliability and usefulness of maps compiled therefrom. The inevitable tendency of adjoining but unrelated cadastral surveys, for example, to coincide only imperfectly, can be corrected by reference to established geodetic standards. Savings in time and money achieved by dispensing with resurveys, in preventing litigation and in better map making are some of the practical benefits flowing from the adoption of a primary pattern or network of triangles.

One of the earliest attempts in Canada to perform geodetic survey work occurred in 1883. Under R. Steckel a geodetic levelling party functioned as an activity of the federal Public Works Department. It operated mainly along the St. Lawrence and Richelieu rivers, establishing permanent bench marks* and working gradually towards the Atlantic coast, with the object of fixing the differences in elevation between mean tide level and inland bench marks. Information on these pioneering efforts is to be found in Steckel's reports to the department in 1885, 1891, 1898 and 1906.

But the need for a federal government organization, basically devoted to geodetic survey work, continued to grow. Thomas Fawcett, who had resumed private practice as a land surveyor following active service in the field during the 1885 campaign against Riel and his followers, took a momentous step. As President of the Dominion Land Surveyors' Association, and on its behalf, Fawcett addressed a memorial dated March 2, 1886, to the Minister of the Interior. He pointed out the pronounced advantages of a Coast and Geodetic Survey for Canada and advocated that its work "be conducted under the direction of the Department of the Interior . . . as it has in its employ a number of surveyors qualified . . . to undertake . . . extensive Governing Surveys, thus rendering it unnecessary to apply to the Imperial Government for scientific men to prosecute such work . . . ". Fawcett also urged that "a chain of primary triangulation along the St. Lawrence River and Gulf, also the Great Lakes, would provide a basis for the extension of the survey into the interior of the different provinces . . . and could readily be connected with the United States Lake Survey . . . it is in the interests of the country at large that a Trigonometrical Survey *should at once be begun.*"[1] (author's italics)

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*Bench mark: a relatively permanent material object, natural or artificial, bearing a marked point whose elevation above or below an adopted datum (usually mean sea level) is known.

To help keep the matter alive the Association appointed a committee of five of its members to study the question in detail and to prepare a further memorandum. Two years later the committee, consisting of W. F. King, O. J. Klotz, W. S. Drewry, E. J. Rainboth and J. S. Dennis, submitted a memorandum of their conclusions to the Minister of the Interior. In their presentation they urged that a geodetic survey of Canada be inaugurated at an estimated annual outlay by the government of $15,000.

In his 1894 presidential address to the Royal Society of Canada Dr. G. M. Dawson commented " . . . it is clear that something in the nature of an established geodetic survey must be ranked as among the requirements *of the immediate future* . . . such a survey is essential as a basis for the complete geographical delineation of any great area . . . ".[2] (author's italics) Actually the accomplishment of this goal remained 15 years away!

In 1899 a memorandum from the Chief Astronomer, addressed to Deville and dated February 5, Dr. King indicated that the work of his office consisted principally of "astronomic and geodetic computations".

In May, 1903, the Royal Society of Canada submitted a memorandum to the Canadian government asking for the appointment of a commission to collect information and report upon the possibility of establishing a Geodetic Survey of Canada. In this submission it was recalled that five years previously the Society had drawn the government's attention to a proposal by the Superintendent of the United States Coast and Geodetic Survey, Dr. Henry S. Pritchett, to measure an arc along the 98th meridian from Acapulco, Mexico, to the Arctic Coast of Canada. This meridian line runs about 100 miles west of Hudson Bay. The object of this exercise was to provide data for the determination of the shape and dimensions of the earth. The Society pointed out that the Canadian part of this work would be of great practical utility in forming the basis of a geographical survey of Canada. The government, however, indicated at the time that it was unable to authorize Canadian participation. This rejection may have arisen from the fact that the proposed project would be carried out in a region then of little economic value or significance to Canada as a whole. The Society, nevertheless, in its 1903 memorandum asked for reconsideration of the matter and urged that the moment was propitious for the formation of a Geodetic Survey of Canada.

In the same document it was emphasized that often the same areas were being surveyed again and again in this country by land surveyors, geologists, railway and hydrographic surveyors. For every new project a fresh survey was made. Such duplication of work and of expenditure, it was argued, could be considerably reduced, if not entirely eliminated, by the establishment of a systematic triangulation net. It was conceded by the Society that few countries, if any, spent as much money per capita for survey work as Canada was doing at the turn of the century. The Department of the Interior was subdividing prairie land as well as parts of British Columbia; the Geological Survey of Canada was exploring and surveying in many parts of the country; the Department of Marine and Fisheries was surveying Canadian navigable waters. It was proposed that if all such information could be connected in a methodical triangulation network it would be possible to take a broader and more comprehensive view of great issues affecting Canada as a whole, rather than attempting to deal with such questions within the limited aspects of purely local and unrelated surveys.[3]

In 1903 also, Major E. H. Hills, R.E., head of the Topographical Section of the British War Office, was sent by that organization to study and report on a topographic survey of Canada as well as to make a report on military surveys in this country. In his report Major Hills stressed the advantages of a trigonometrical type of survey and contended that the Royal Society of Canada had been correct in its assessment that the triangulation method was desirable as a basis for other Canadian surveying activities. Major Hills found that existing survey practices in this country were both costly and inefficient and recommended that a topographic survey along systematic lines was an urgent necessity for military, administrative and engineering purposes.[4]

Chief Geographer James White contributed to the growing demand for a geodetic survey by alluding in his report to the Interior Department in 1902 to the difficulties of compiling a new map of Canada. "The lack of an accurate topographic survey", he stated, "the numerous sources from which information must be obtained; the difficulty in many cases of obtaining access to the plans of old and almost forgotten surveys; the necessity of incorporating surveys that are being made concurrently with the compilation of the map which frequently alter the work almost as soon as completed; . . . all tend to make the compilation of such a map a long and tedious operation . . . The difficulties encountered in compiling the new map of Canada emphasize the need of a good topographical map of at least the well settled portion of the Dominion. A few years ago I made a survey between two well determined points on Georgian Bay and Lake Ontario, respectively, which showed that part of Central Ontario, as shown on the best existing maps, was over two miles out in longitude and over a mile in error in latitude. Although our maps show streams, lakes, etc., even in the extreme north, much of the information on which this is based is of the vaguest kind."[5]

Leading up to geodetic survey developments in 1905 were surveys of that description authorized by the federal government for geodetic levelling work in connection with the Georgian Bay Ship Canal project. These tasks were carried out by a staff under Charles F. X. Chaloner, an experienced assistant to Steckel. The canal levelling surveys were made in late 1904 to November, 1906. Instruments used included the Tacheometre Sanguet made in France, under Steckel's direction, for the Department of Public Works.[6]

Field operations of the Geodetic Survey, under the ultimate responsibility of Chief Astronomer King, commenced in the summer of 1905. These operations marked the real, rather than the official, beginnings of the Geodetic Survey of Canada. Dominion land surveyor Charles Albert Bigger (1853-1923) of the Dominion Observatory staff, was in direct charge of these activities. The project was designed as a triangulation survey in the more settled parts of Ontario and Quebec and was undertaken primarily to connect the old and new observatories in Ottawa.* In 1905-06 the tiny staff of the organization was given office accommodation in the Dominion Observatory, Ottawa, but in the autumn of 1907 it was found necessary to provide more space and this was secured in the Trafalgar Building downtown. In 1914, partly as a result of recommendations of the 1907 committee that a central record office be made available to the Geodetic Survey in a suitable fireproof structure, the staff moved into a new brick building on the grounds of the Central Experimental Farm near the Irving Avenue entrance. This move marked the commencement of a 45-year occupation of those premises.

As early as the summer of 1905 the Department of Militia and Defence had requested that triangulation for topographic purposes be undertaken in central Canada, pending specific provision by Parliament for such a survey. Early in February, 1906, a memorial was drawn up and later forwarded to Sir Wilfrid Laurier by the Canadian Society of Civil Engineers, urging upon the federal government the importance of proper coordination of the various surveys conducted by several federal departments and also the adoption of methods to provide for permanent recording by monuments and other field marks. A study by a commission of experts was suggested as well, with the aim of establishing a general topographic and geodetic survey for all Canada.[7]

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*Located on Cliff Street and on the Central Experimental Farm respectively.

FIGURE 95. Geodetic Survey of Canada building, Ottawa, 1914.

The government of the day decided that, all in all, a committee of government and other officials, rather than the device of a more ponderous and more expensive commission, could serve just as effectively as an investigating and reporting body. Accordingly, in 1907, a committee was approved and instructed to consider and report on matters raised in the submission of the Civil Engineers. A fairly representative committee was convened under the chairmanship of Dr. King. It consisted of the deputy minister of Railways and Canals; the deputy head of the Geological Survey of Canada; the Chief of the General Staff, Department of Militia and Defence; Surveyor General Deville; Chief Clerk of the Engineering Branch, Department of Public Works; the Chief Hydrographic Surveyor, Marine and Fisheries Department, and three professors of surveying and geodesy from McGill, Toronto and Laval universities respectively.

The committee reported its findings to the Minister of Militia and Defence in mid-February, 1907. The committee expressed itself as strongly in favor of a comprehensive and reliable survey of Canada for the production of an accurate topographic map based on a network of triangulation and showing natural and artificial features of the country. Such a survey, in the view of the committee, was of urgent necessity to the people of Canada from the standpoint of public economy, extension of public projects and the development of the natural resources of this country. The benefits of such a survey, it was indicated, would be political, administrative, military, statistical and economic in nature. Better delineation of Canadian coastlines would be another dividend. The best interests of the nation would be served, the committee asserted, by the early production of accurate maps and the avoidance of duplication and overlapping in federal surveying activities. "For the proper coordination of existing surveys and the effectual control of future surveys it is recommended to establish in a permanent manner a network of triangulation . . . chains of required geodetic triangulations and nets of precise spirit levelling."[8]

In June, 1905, Canadian geodetic survey work began in earnest at Kingsmere, Quebec, not far from Ottawa. On July 23 the first station was erected on King Mountain, about 9 miles northwest of Parliament Hill. During the same season an 87-foot-high observation tower was built at Bowesville, south of Ottawa. Visible signs of geodetic work in the countryside were the wooden observation towers resembling primitive oil well derricks. The sudden appearance of novel structures aroused wonderment among residents in their vicinity. Strange explanations were provided by the uninformed for the presence of the towers. It was rumored, for example, that these structures had been erected in preparation for the next general election, thus permitting political orators, armed with megaphones, to glorify and even perpetuate the government of the day!

Bigger's description of this work is illuminating. "The survey", he stated, "is spread over the country trigonometrically, by triangles, starting from a measured base having the angles of the triangles measured, and their sides computed. The triangles selected are combined to form a multi-sided figure for more precise computation of distance. The angles of the triangles are measured . . . by theodolites."

Winter seasons proved best for geodetic reconnaissance work, including the selection

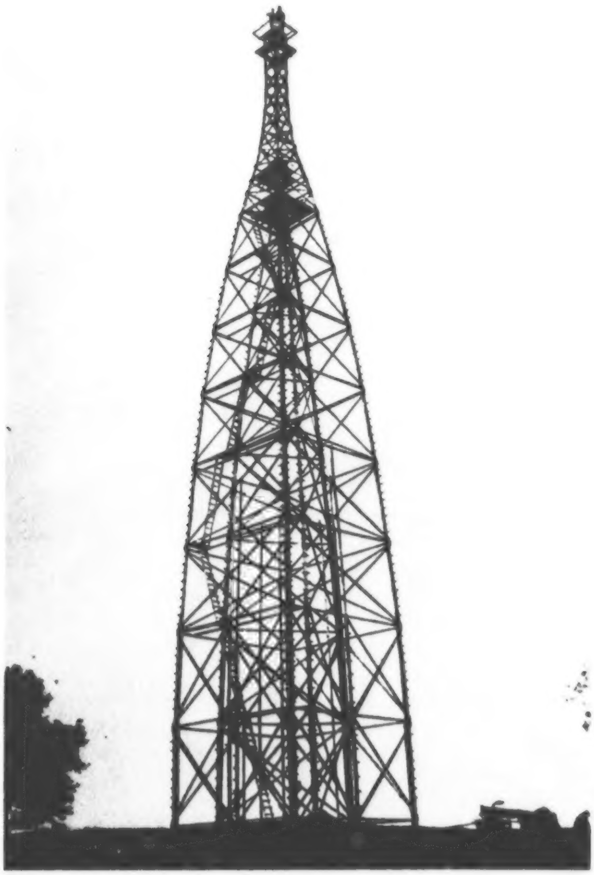

FIGURE 96
Observing tower near Chatham, Ontario, constructed in 1911.

of sites for observation towers. The absence of foliage and the presence of snow-cover on hilltops combined to reveal any irregularities of the horizon.

Each surveyor was equipped with a small theodolite, a compass, telescope, field glasses and a pair of heel spikes similar to those commonly used by telephone pole repairmen. At the day's end occupied stations were marked on maps and lines radiating therefrom to other possible stations were plotted.

In the 1906 field season a total of 9 towers, averaging 75 feet in height, were erected and reconnaissance was extended east and west from Ottawa. But government funds remained skimpy for these purposes and the work slackened. During the winter of 1906-07 Bigger and an assistant continued reconnaissance work from Ottawa across the southern part of Quebec province. By 1907 the measurement of horizontal angles was under way and all observers on the staff were Canadian university graduates. The typical observing party consisted of a surveyor, a recorder, a cook and 5 or 6 light-keepers. The latter displayed lights from tower tops, by day using a mirror to reflect a beam of sunlight, at night directing a beam by acetylene gas lamp. The provision of apparatus for signalling, reported as highly satisfactory in other countries, proved somewhat less efficient in atmospheric conditions prevailing in central Canada. A pencil of light many miles in length near the earth's surface is subjected to local atmospheric influences that cause deflections in magnitude and direction. Variation in temperature and in wind force as well as the sharp contrasts between cultivated countryside and timbered areas also contributed to irregularities in the transmission of signals.[9]

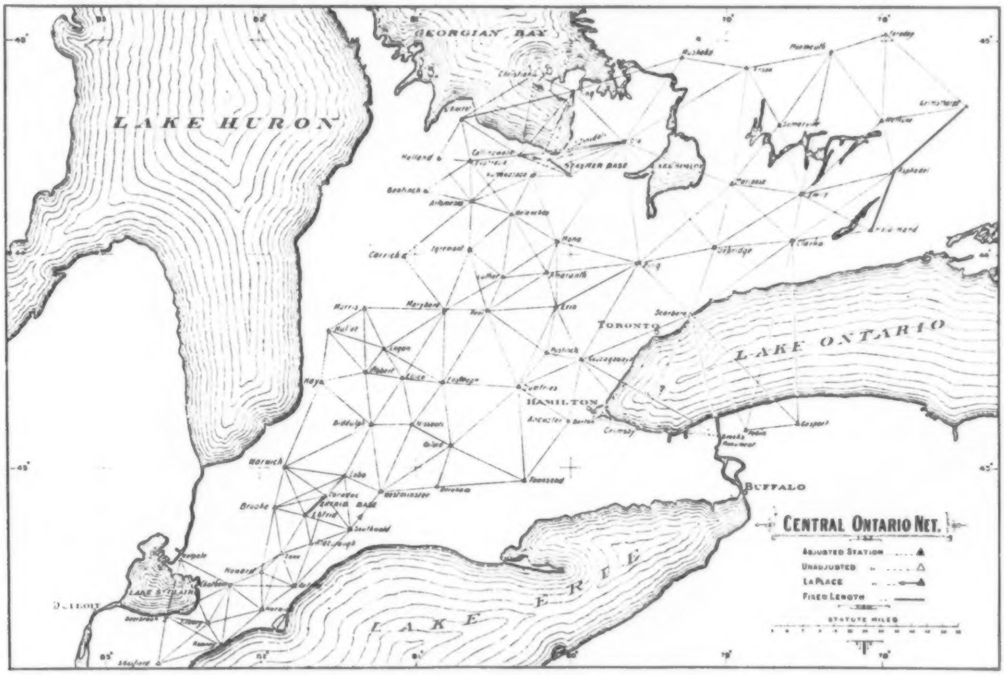
GEORGIAN BAY
LAKE HURON
LAKE ONTARIO
LAKE ERIE
LAKE ST. CLAIR
TORONTO
HAMILTON
BUFFALO
Christiana
Holland
Arkwright
Carrick
Morris
Maryboro
Hullet
Logan
Moya
Biddulph
Nissouri
Warwick
Lobo
Brooke
Westminster
Southwold
Howard
Mono
King
Uxbridge
Clarke
Amaranth
Erin
Peel
Scarboro
Dumfries
Ancaster
Barton
Grimsby
Townsend
Gasport
Muskoka
Tryon
Somerville
Grimsthorpe
Raphael
CENTRAL ONTARIO NET.
ADJUSTED STATION ▲
UNADJUSTED △
LA PLACE
FIXED LENGTH
STATUTE MILES

FIGURE 97. Central Ontario net, constructed 1907-17.

During the 1908 season two levelling parties were active, one extending levels from Sherbrooke along the Canadian Pacific Railway line from Coteau to Polycarpe Junction, thence along the Canadian Pacific line by way of Kemptville Junction to Prescott, then westerly along the main line of the Grand Trunk Railway. Levelling parties, in subsequent years, usually consisted of an observer, a cook and four other men.

April 20, 1909, is regarded as the official birthday of the Geodetic Survey of Canada. On that day Order in Council P.C. 766 was approved and the title of the organization, already in fairly frequent use, was accorded legal status. The text of the Order in Council bears repeating here:

"On a Memorandum dated 5th April, 1909, from the Minister of the Interior, submitting that during the last four years a triangulation has been in progress in the better settled parts of the Provinces of Ontario and Quebec, under the Astronomical Branch of the Department of the Interior, the object of which is to determine with the highest attainable accuracy the positions of points throughout the country, and the lengths and directions of lines which may form the basis of surveys for all purposes, topographical, engineering or cadastral, and thereby assist in the survey work carried on by other Departments of the Dominion Government, by the Provincial Governments, and by municipalities, private persons or corporations. The operations have also included a considerable length of lines of precise levelling.

"The expense of the work has been paid out of the appropriation for Astronomical Surveys, which among other objects, provides for 'the astronomical and geodetic work of the Department of the Interior'.

"The Minister recommends that since the operations so far carried on have shown that this accurate basis for surveys of all kinds can be provided for at reasonable cost and since the value of such work is universally admitted, being vouched for by world-wide experience, that the work be continued under the designation of the Geodetic Survey of Canada and that Dr. W. F. King, the Chief Astronomer, be named Superintendent of the same."

From the time it came into being a policy of cooperation with the United States as well as with the various provinces and cities of Canada was followed by the Geodetic Survey of this country. An outstanding demonstration of this policy in action was the adoption by Canada of what came later to be known as the North American Datum. Early in 1913, after conferring with the United States Coast and Geodetic Survey, the Canadian organization agreed (as did Mexican authorities) to adopt United States Standard Datum as applicable in Canada and the name was subsequently altered to North American Datum. In this way Canada was able to make use of a system which otherwise could not have been established in this country except by costly operations extending over a period of many years. In addition, Canadian geodetic work in Canada and American geodetic work in the United States were joined together, and the respective national nets adjusted to fit together. One notable example of this type of cooperation was in the triangulation from the Lake of the Woods across 1,250 miles to the Pacific Ocean. Another was in the forming of a loop from Montreal down the St. Lawrence River and Gulf, to Anticosti Island, thence along the New Brunswick coast to the Bay of Fundy, joining the eastern end of the United States arc which provided a link through the New England states to the starting point at Montreal.[10]

Within Canada another aspect of this cooperative attitude consisted in occasional arrangements made with municipalities under which triangulation and precise levelling, required in the production of city maps and plans, were carried on by the Geodetic Survey. The Survey provided the engineer and his instruments, the city paying for materials and labor.

By 1916 the first Canadian transcontinental line of precise levels had been completed. Results of these operations, after 1913, were published from time to time. By the end of 1925 a total of 17,021 miles of precise levelling had been run, in addition to 10,000 miles of secondary levelling. Most of the 17,021 miles of survey had been performed since the beginning of 1912.[11] All of these lines of precise levels were connected to establish a single system extending from coast to coast. The system was based on five tidal stations, namely, Halifax, Yarmouth, and Father Point on the Atlantic seaboard; Vancouver and Prince Rupert on the Pacific. About 94 per cent of this levelling work had been carried along railway tracks. In many instances such lines formed the only routes available for running levels.

FIGURE 98
Noel J. Ogilvie.

The proliferation of railway lines in Canada during the first decade of the 20th century benefitted triangulation programs as travel to the field became much easier. In the same period the introduction of invar tapes proved to be a boon to geodetic work by making possible more accurate measurements of base lines from which triangles were expanded. These tapes, made of an alloy of steel and nickel, had a very small temperature coefficient. By 1925 the total area of triangulation work that had been completed by the Geodetic Survey of Canada had reached 170,000 square miles.

From 1904 to 1911 inclusive, descriptions of fiscal year activities of the Geodetic Survey of Canada were contained in annual reports of the Chief Astronomer. From 1912 on, with the exception of the period from 1919 to 1921, the Deputy Minister of the Interior summarized geodetic survey work in Canada in his yearly report. In addition, from 1918 to 1929 inclusive, annual reports of the Geodetic Survey of Canada were published in red-covered, attractively printed and well-illustrated volumes.

By the end of the first decade of its legal existence some of the more important groundwork for future expansion of the Geodetic Survey of Canada had been laid by its first Superintendent, Dr. W. F. King. In his administrative capacity he was ably helped by Assistant Superintendent Charles Albert Bigger. This highly competent Dominion and Ontario land surveyor, born in Oakville, contributed in a marked way to the general advancement of geodetic surveys in Canada. In 1905 he began his close association with Dr. King, following several seasons on resurveys of the boundary between Quebec and New York state, as well as the boundary between this country and Alaska. His direction of field parties engaged in carrying out geodetic assignments was outstanding, and until his death in 1923 Bigger's wisdom and diligence proved to be important factors in the development of an efficient organization.

Other Dominion land surveyors active in this type of survey work in pioneer times include Picton-born Wilmot Maxwell Tobey, D.T.S. (1877-1959). In 1901 Tobey was appointed mathematician to Chief Astronomer King. He wrote such works as *Geodesy*, *Geodetic Position Evaluation* and *The Differential Adjustment of Observations*, all federal government publications. The latter work came into extensive use in the readjustment of triangulation networks. In 1926 Tobey became Assistant Director.

Frederick Blair Reid, Supervisor of Levelling, issued a series of reports during the period 1910 to 1917 under the general title, *Precise Levelling*. All of these were publications of the Dominion Observatory, Ottawa. In 1912 Douglas H. Nelles, as a result of initial geodetic work in the Yukon Territory, made a report published as *Precise Levels Along Dawson and Glacier Roads from White Pass, B.C., to the 141st Meridian*. Later Nelles became Supervisor of Topography in the Geodetic Survey of Canada. Royal Harp Montgomery, D.T.S., foresaw, through his geodetic field work, that increased water-power development in this country would be accompanied inevitably by a brisk demand for vertical control in areas forming watersheds of our large river systems. William Melbern Dennis, in addition to other accomplishments, became an expert on instruments used on geodetic surveys. With Rannie he studied ways and means of improving their accuracy. Geodetic engineers such as W. H. MacTavish, A. J. Brabazon, A. J. Rainboth, Thomas Clinton Dennis and David MacMillan (1888-) performed valuable services during formative years of the Survey. F. A. McDiarmid's work as Geodetic Astronomer, including measurements of base lines, and as Supervisor of Standards, deserves special mention.

All of these well-trained, dedicated men helped to make possible subsequent accomplishments by such eminent Canadian geodetic and Dominion land surveyors as Noel John Ogilvie, John Leslie Rannie, D.T.S. (1886-1954), John Earl R. Ross, D.T.S. (1892-) and Cecil Herman 'Marsh' Ney. By 1917 Rannie was Supervisor of Triangulation. In time both Rannie and Ross, in that order, occupied the post of Dominion Geodesist as the directorship came to be called after 1936. Noel Ogilvie, as assistant to Dr. King, succeeded his distinguished chief after King's death in 1916.[12] His appointment as Superintendent in the following year marked the separation of the Geodetic Survey of Canada from the Dominion Observatory. By 1923 his title had been changed to that of Director. Noel's father, John Charles Ogilvie, was a first cousin of William Ogilvie of Klondike surveys fame. Noel was born in Hull, Quebec, in 1880. One of his private tutors was Dominion land surveyor Carl Engler who coached the young man in mathematics, surveying and astronomy. In 1901 Noel began his surveying career with the Department of the Interior under Deville, and in 1902 worked in the western interior with the Dominion land surveyor, Edgar Bray. Between then and 1905, when he was commissioned a Dominion land surveyor, Ogilvie was with J. J. McArthur in the Kootenay area. From 1909 to 1914 he worked on surveys of the Canada-Alaska boundary. Noel Ogilvie's span of leadership of the Geodetic Survey of Canada covered nearly 30 years until his retirement in 1946.

13

TYPICAL SURVEYS ON PIONEER CANADIAN RAILWAYS OTHER THAN THE C.P.R.

The clash of strong personalities, the plots and counterplots that accompanied the creation and growth of corporate entities, the intensive money-raising campaigns, the engineering accomplishments and political strife stimulated by the advent of the railway age in British North America invite attention. However, except for the vitally important part played by surveying and mapping in Canadian railway building, these aspects are too varied and far-ranging to find place in this account.

In a previous chapter the work of surveyors in the establishment of the transcontinental line of the Canadian Pacific and of its lands in the West has been traced. In order, however, to portray the function of surveys entering into the wider spectrum of railway construction in Canada this chapter offers some examples typical of the total achievement.

News of the startling success of the Liverpool and Manchester line of steam railways in the early 1830s triggered a veritable explosion of interest and action in the western world. In the 1840s a mania for purchasing rail shares swept the London money market, a boom in which nearly all classes of society participated. In one week in the summer of 1845 some 89 new railway projects were financed by funds raised in the British metropolis. Canadians were not immune to the construction virus but remained somewhat less susceptible to stock-gambling fever. The energetic initiation of railway-building in the United States contributed to the contagion in Canada. By 1840 a total of 2,800 miles of railway had been completed in that country.

Montrealers were in the forefront of early developments in this new field of endeavor in Canada. In their enthusiastic drive to compete with New York for traffic, rails began to supplement the services of canals. A natural freighting route lay between Montreal and St. John's, at the head of the Richelieu River-Lake Champlain water transport system. In order to carry on business between these two points early traders had to cross some 14 miles of countryside. This important travel-way was the first to attract pioneer railway builders in this country, men who were spurred by prospects of relatively substantial traffic, short haulages and heavy tolls. On February 25, 1832, a bill incorporating the Champlain and St. Lawrence Railroad Company was passed in Lower Canada. Soon after the organization of the corporation in 1834, initial surveys of the route were made. The broad-gauge line, consisting of wooden rails, ran from St. John's to Laprairie on the south shore opposite Montreal. On July 21, 1836, the road was formally opened but it was not until 1847 that heavy 'T-iron' rails replaced the wooden ones.

FIGURE 99. The *Dorchester* at the opening of the Champlain and St. Lawrence Railway between Laprairie and St. Johns, Quebec, July 21, 1837.

In the first ten years following the Act of Union the building of railways was one subject prominent in public affairs of the new Province of Canada in which regional or sectarian considerations played little or no part. Hardly anyone opposed railway construction. Most Canadians regarded railways as a magic talisman of prosperity, a tangible measure of progress and a badge of achievement. In 1845 the St. Lawrence and Atlantic Railway was chartered for the purpose of building a 125-mile-long line to the international border through Sherbrooke in order to link up with its American counterpart, the Atlantic and St. Lawrence Railway, and thus provide communication between Portland, Maine, and Montreal. This project would afford the Canadian city access to an open port in winter. In all probability this was the first railway of an international character in the world.

Lack of easy communication and of trading contacts impeded the growth of a common nationality among the various provinces of British North America. The establishment of satisfactory rail links with the Province of Canada was, in fact, the price set by the mainland maritime provinces and by British Columbia for entrance into political union with Canada East and Canada West. More than most parts of the western world at the time, the colonies of British North America required rail communications to help offset the depressing sense of isolation that afflicted pioneer settlers and communities scattered across immense expanses of forest, mountain and plain.

The first railway to be built in Canada West was constructed by the Erie and Ontario Company. It was chartered in 1835 and four years later its line was opened for traffic. Its first trains were horse-drawn. By 1857 a total of eleven railways were operating in the Province of Canada, representing a total of 1,402 miles of track. Two years later that mileage had risen to 1,871 of which 1,372 miles existed in Canada West and 499 in Canada East.

Two civil engineers named Keefer were prominent in railway and related surveys in Canada during this formative period. Their father, George Keefer, had left the United States as a United Loyalist and settled in the Niagara Peninsula. He founded the town of Thorold and served as first president of the Welland Canal Company. His son Samuel Keefer (1811-90) was for many years a government engineer and supervised the planning of the first Parliament Buildings in Ottawa and of a suspension bridge over the Niagara River. His half-brother, Thomas Coltrin Keefer (1821-1915) produced in 1851 the preliminary survey report of the Kingston-Toronto section of the Grand Trunk Railway.

Early achievements in railway building in Canada East were imposing but it soon became apparent that the St. Lawrence River at Montreal had to be crossed if full benefits of the new age in transportation were to be realized. Many experts of that day felt it was quite impossible to build a bridge nearly two miles long yet high enough to permit the passage of large vessels beneath it. In addition the structure had to be made strong enough to withstand the unusual pressures exerted by huge ice jams in winter and turbulent high water in spring. At this stage two able surveyors, T. C. Keefer and Alfred Brunel, appeared on the scene, men whose deeds shed lustre on the engineering profession in Canada. In 1851-52 Keefer, assisted by Brunel, completed surveys in contemplation of a railway bridge across the St. Lawrence at Montreal.[1]

As a result of this examination of the problem, Point St. Charles was selected as the best place of entry for the bridge on the north bank. In order to neutralize extreme ice pressures special bridge piers were designed and built so that their sharp edges faced into the strong currents of the river. In May, 1854, the first caisson was placed in position and by the end of November, 1859, Victoria Bridge, as it was named, was completed. On December 15 the first train crossed safely. Victoria Bridge remains a monument to bold concepts, wise surveys and dedicated, skilled workmanship.

Another engineer and surveyor who rose to prominence in the field of Canadian railway construction was Col. (Sir) Casimir Stanislaus Gzowski (1813-98). Son of a Polish nobleman, Gzowski arrived in Canada in 1842 by way of Russia and the United States. After serving as a government engineer for six years supervising road-building in Canada West, Gzowski was attracted to construction work with the St. Lawrence and Atlantic Railway. In 1853 he entered into partnership with (Sir) Alexander Tilloch Galt (1817-93), son of John Galt of Canada Company fame. This partnership built much of the Grand Trunk Railway from Toronto to Sarnia. Galt, a leader of English-speaking elements in Canada East was one of the principal architects of the Act of Confederation and was the first finance minister at Ottawa after July 1, 1867. He became the first to occupy the post of Canadian High Commissioner in London.

Gzowski had many noteworthy surveying and engineering feats to his credit including the undertaking and successful completion in 1872 of the Grand Trunk's International Railway Bridge across the Niagara River at Fort Erie. Even at the crest of his long and eventful career Gzowski vividly remembered his earliest employment in this country. In an address delivered in 1890 to the Canadian Society of Civil Engineers, now the Engineering Institute of Canada, he recalled that "during the administration of . . . Sir Charles Bagot, Governor General, I was appointed in 1842 in charge of construction of all kinds of roads [plank, macadam, etc.,] harbours, lighthouses and bridges, not including the Welland Canal; that work was under charge of . . . Samuel Keefer, at that time . . . chief engineer of Public Works in Upper and Lower Canada . . . the roads were made by cutting down trees for a certain width on each side of the centre line, but only blazing those standing on or near the boundaries of the 66-foot statutory road allowance. The setting of these allowances for roads was done with ordinary compasses by amateur surveyors . . . The Act respecting land surveyors requiring them to pass examinations before being allowed to practice had not yet been passed."[2]

The Ontario, Simcoe and Huron Union Railway, which became part of the Northern Railway Company, occupies a special place in the history of overland transportation in Canada. A bronze plaque, attached to a column at the portal of Toronto's Union Station, records for posterity a pioneer achievement of this line. The inscription proclaims that "at this place on May 16, 1853, the first train in Ontario [Canada West] hauled by a steam locomotive started and ran to Aurora". The cheers and happy shouts heard on that auspicious occasion have come echoing down the years but in the interests of accuracy it should be pointed out that the plaque ought to have been placed one block to the east of its present location.[3] Passengers, hauled by a wood-burning locomotive, paid one dollar each for the privilege of making this historic 30-mile journey to Aurora. Rails of this line, in the first years of its operations, reached to a point near Barrie. The inauguration of this passenger service heralded the advent of a period of vigorous railway building in this part of Canada, lasting through the 1850s. The event signified as well the emergence of Canada West from an economy based on water transport to a more industrial form of society based upon improved overland transportation.

Two exploratory surveys had been made by the company beyond Barrie toward Nottawasaga Bay, Lake Huron. Sandford Fleming and Alfred Brunel were engaged to carry out a more determinative survey. Their final choice for a terminal site on the bay, out of five possibilities, was a nameless swamp in the lee of offshore islands known as Hen and Chickens. In January, 1853, railway officials met at the place and christened it Collingwood. Within seven years after the railway's arrival there, Collingwood was a thriving town of several thousand inhabitants.

In 1888 the Northern Railway Company was absorbed by the Grand Trunk. By that time its lines had been extended to Meaford and to Penetanguishene on Lake Huron and to North Bay through Bracebridge and Huntsville. The Northern was the first rail line to break through into the Ontario northland where it became a principal factor in the revival of the timber industry in that region. It was also a nursery of Canadian railway management and engineering.

Meanwhile the prospect of railway construction had enlivened public and private affairs in the provinces by the Atlantic. Rail communications between the seaboard and the Upper St. Lawrence Valley had excited the interest and stirred the ambitions of maritimers as early as 1835. In that year an association of interested persons was formed in St. Andrews, New Brunswick, to promote the project. Two members of the group were authorized to conduct an exploratory survey of the hinterland between that community and the St. Lawrence escarpment, despite the fact that this region was already under preliminary examination by an international team composed of members of the United States Topographic Corps and of the Royal Engineers. In 1836 Capt. Yule, R.E., made a 200-mile preliminary survey from Point Levis to Mars Hill in order to determine the most feasible route for a railway. On vigorous representations from Washington, D.C., further surveying in the region was suspended until the international boundary dispute then raging in that general area was officially settled. Not until after the Webster-Ashburton Treaty of 1842 was another British survey undertaken with a view to linking Quebec by rail to Atlantic ports.

The Maritimes

After prolonged negotiations between Canadian and British statesmen, Westminster authorities were prevailed upon to instruct the Royal Engineers to make an accurate survey to ascertain the feasibility of a rail route from the Atlantic seaboard to the St. Lawrence River. Capt. Pipon and Lieut. Henderson were active on this task until October, 1846, when Pipon was drowned trying to save the life of another member of the survey party. Henderson carried on in charge until the summer of the following year when Major William Robinson succeeded him. On August 31, 1848, Robinson reported on five possible routes, including one from Halifax to the Baie de Chaleur via Truro, then up the Matapedia Valley to Mont Joli, a distance of 652 miles. The total cost of such a line was estimated at four and a half million pounds. The cost of the survey was slightly in excess of fourteen and a half thousand pounds.

In a letter dated August 6, 1847, one Wilkinson, a surveyor, wrote to Major Robinson giving instructions to the men in the field: "... I place no very strong reliance upon the Maps. But if a favorable opening . . . be found . . . [Corporal] M'Kenzie will continue levelling down the Restigouche slope until he strike[s] the exploratory north line levelled by Capt. Broughton and Mr. Featherstonaugh, at some point to be identified. Here he may cease levelling, and make thence a compass survey . . .".

Robinson, in a letter, referred to an example of the dangers and hardships encountered on this survey. Mr. Grant, one of the chief surveyors in his party "having left the line for a short time to make a sketch from some rising ground, could not again find the track, and after being lost for 5 days, without a morsel of food, was found on the morning of the sixth day, lying exhausted and at last extremity, by some lumberman passing almost providentially up the stream to which he had wandered, and where, unable to move farther, he had laid down on the top of the bank for two days. This solitary boat was, in all probability, the only one passing that way for a twelvemonth. Mr. Grant's hands and feet were frost-bitten and though this happened a month and a half ago [in early November, 1847], he had not yet fully regained the use of them".[4]

In one of the most significant state papers ever compiled in the English language Lord Durham had helped clear the way for the railway survey. It was in January, 1839, that he presented to Westminster his now-famous ***Report on the Affairs of British North America***. In this perceptive analysis of Canadian conditions and in his statesmanlike remedies for Canadian problems of the time, Durham proposed the ideas of legislative union, actually consummated two years later, and of local autonomy for the several colonies. What is often overlooked is that Durham also observed that "the completion of any satisfactory communication between Halifax and Quebec, would, in fact, produce relations between these Provinces that would render union absolutely necessary". This proved to be a remarkably shrewd prophecy. Durham added, "Several surveys have proved that a railroad would be perfectly practicable the whole way".[5]

In the mainland Atlantic provinces the colonial governments undertook construction and management of rail lines within their respective boundaries during the period when negotiations with British authorities for financing the Intercolonial line, as the Halifax-Quebec rail link was called, had broken down. In 1848 Joseph Howe entrusted George Wightman, for example, with the task of conducting a railway survey from Halifax to Windsor, N.S. In the expansive manner of the times, Wightman's report dealt with nearly every aspect of railroading. His report is especially significant because it bore a distinctively Canadian, rather than a British or American, flavor. Wightman pondered over such typical Canadian construction problems as the effects of severe frost on roadbeds, the advantages and disadvantages of winter construction, and the behavior of subsoils. His findings, in all likelihood, contributed substantially to the technical improvements in Canadian railway-building practices later introduced by Fleming.

In the spring of 1850 the Nova Scotia legislature promised to subscribe half the cost of the Halifax-Windsor line and, in addition, ordered a survey to be made along the Annapolis Valley from Windsor to Digby Gut, about 90 miles. On December 15, 1858, a rail line was opened to traffic on the 61-mile stretch from Halifax to Truro. By 1860 a line between Saint John and Shediac, about 108 miles, was in operation. In this patchwork manner, and without any real unity of plan, the provinces of Canada, New Brunswick and Nova Scotia determined, within the scope of their own limited financial resources, to commence work at various points in the fond hope that the bits and pieces might one day become a connected system. In a sense these developments marked the real beginning of the Intercolonial Railway.

On March 14, 1851, after alternately hopeful and discouraging discussions, the British government offered to guarantee payments of interest on railway loans floated by provincial legislatures to promote the Intercolonial project but Westminster authorities insisted that the three million pounds sterling involved would not be forthcoming until preliminary surveys for the line had been completed and the final location approved by the British government. It was also stipulated that such surveys were to be carried out by three engineers, one to be appointed by the British, one by the Province of Canada, and one by New Brunswick and Nova Scotia, acting jointly. In the event, all three parties appointed the same man for the purpose, Sandford Fleming.[6] The Colonial Secretary, the Duke of Newcastle, praised Fleming's character as "unexceptionable" in his communication agreeing to the combined selection.[7]

Fleming began his reconnaissance survey on March 5, 1864. He divided the work between two regions; the Nova Scotia Division, and the New Brunswick and Canada Division. Each survey party consisted of the engineer in charge and men trained to carry on levelling, surveying and barometric observations, together with a full complement of axemen and packmen. Four civil engineers headed as many parties: Walter Lawson, T. S. Rubidge, David Stark and Sandford Fleming himself. The main object of these 1864 surveys was to gather information to enable the governments concerned to judge the comparative merits of some 15 projected routes for the proposed Intercolonial Railway. Rails had reached Rivière-du-Loup from the west and the Halifax-Truro line was in operation, so that the portion of the line to be provided for was that between Truro and Rivière-du-Loup, or 360 miles on a direct line. Once again, as in most reports in the long history of Canadian surveying reference is made to the very trying onslaughts of insects. "Various kinds of flies were more than usually troublesome during the first half of the season. The parties engaged in the northern section of country suffered very much", reported Fleming.[8]

In all, three main routes were accorded priority in Fleming's report made in February, 1865, namely, the Frontier, Central, and Baie de Chaleur routes. Fleming was not to decide at the time on the best route but to leave the choice to the governments. Several years later,

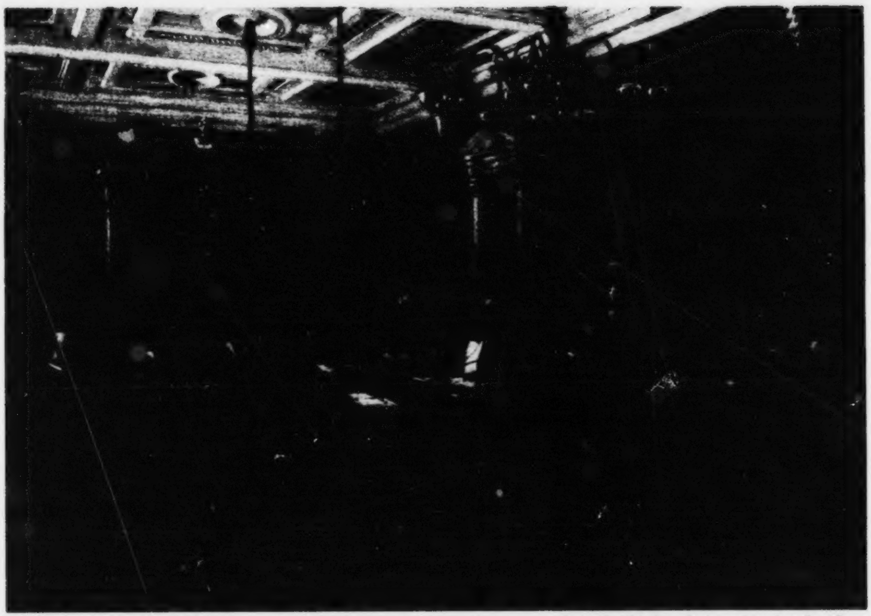

FIGURE 100. Fathers of the Canadian Confederation discussing terms of the British North America Act, London, England, on Christmas Eve, 1866.

at the request of government authorities, he did indicate his preference for the Baie de Chaleur route. While the survey was in progress in 1864 important and rapid moves were being made by men in public life in British North America looking towards a confederation of the provinces. In July, at Charlottetown, and in October, at Quebec, developments towards this union came in rapid succession. These culminated in an arrangement that provided, among other matters, for the construction of a railway system which other efforts, extending over a quarter-century, had failed to secure. Above all they resulted in the consolidation, under one central government, of provinces reaching across the northern half of the continent.

In a report to Hon. William McDougall, Provincial Secretary, in February, 1865, regarding his Intercolonial survey, Fleming expressed what may well be regarded as the credo of Canadian surveyors of the past, present and future. "I have endeavored", he wrote, "to carry on the Survey with a strict regard to economy, at the same time efficiency, and I have completed the whole service at as early a period as it was possible, within the means at my command".

Construction work on the Intercolonial system continued for more than nine years. In 1876 the whole length of line, over its rather circuitous route, was opened for traffic, touching six Atlantic ports and extending over a total length of 700 miles.[9] The Intercolonial continued to operate under that name until 1923 when, along with other lines, it was absorbed into the Canadian National system.

A map drawn on Mercator's Projection, showing the relative geographical positions of the British Islands and British America, with the shortest lines across the Atlantic also depicted, formed an appendage to Fleming's 1865 report of survey. In the matter of new geographical concepts Fleming gave an address in London in 1878 that contained passages of special interest to any involved in transportation problems peculiar to Canada.[10] "If on the surface of a large terrestrial globe [upon which all the land and water on the earth's surface were depicted on the same scale] we draw on one sheet of tracing paper the outlines of Canada and on another, the outlines of Europe, and then proceed to lay one over the other so as to cover as much of the land in each case as possible, and if we go on to measure and make allowance for portions left uncovered, we shall find that Europe somewhat exceeds the area of Canada but that the excess is not great . . . If we exclude from the comparison all land within the Arctic Circle, we still find that Canada covers fully more of the earth's surface than the comprised areas of European Russia, Lapland, Norway, Sweden, Denmark, Holland, Belgium, the British Isles, France, Switzerland, Germany, Austria, Turkey and all the principalities between the Adriatic and Black Seas. In fact if we leave out Spain and Italy, Canada appears to equal in area the remainder of Europe".

And again, " . . . To an Englishman or Frenchman the Severn or Thames, Seine or Rhone, would appear to be considerable streams but in the Ottawa which reaches its parent stream, the St. Lawrence, 600 miles from the latter's mouth, we have a river 550 miles long, three or four times as big as any of them". Also, "Compared with some of the [Canadian] lakes and rivers, the canals are unimportant but they will stand comparison with any works of their class. As engineering achievements I believe I am correct in saying they are unrivalled. They are certainly as much superior to the canals of the United States as the latter are in advance of anything I have seen in England".

The Central Provinces

In the Province of Canada three corporations, the Northern, Great Western, and Grand Trunk were the most prominent among early railway lines. In many cases early lines were but links in longer transportation systems or chains. For example, the Northern Railway line from Toronto to Collingwood was primarily a portage road between Lake Ontario and Lake Huron. The Grand Trunk Railway was the largest of the three corporations but all hoped to attract substantial east-west traffic in Canada. The Grand Trunk reached from Sarnia to Montreal and Portland, thus reinforcing the traditional flow of commerce in the St. Lawrence River valley.

In 1854 the Grand Trunk completed a survey of the Montreal-Toronto section and during that summer about 8,000 men worked on the right-of-way. But the mid-1850s were unsettled times. The Crimean War raged in Europe and on the Pacific side of British North America the San Juan crisis bedevilled Canadian-American relations. Canadians generally were given a timely lift in morale when, on October 27, 1856, the 333-mile-long Grand Trunk rail link between the two principal urban areas of the Province of Canada was formally opened for business. Stirring civic celebrations were held at Cornwall, Prescott, Brockville, Kingston, Belleville and Cobourg. For the first time in Canada's history morning newspapers published in Toronto could be read later the same day in Montreal, and vice versa. The same feelings of wonderment, even elation, over man's conquest of time and space, must have been experienced in 1856 as those that stirred Canadians about a century later when daily air flights made it possible for passengers to breakfast in Montreal and to dine in Vancouver before sunset on the same day.

Adequate provisioning was the magic key to the safety and well-being of nearly a thousand men performing arduous surveying duties along the National Transcontinental line, the eastern division of the Grand Trunk Pacific, a section for which the federal government was mainly responsible. These surveys began in the autumn of 1903 and continued through the following year. In the spring of 1905 some 34 location survey parties were at work for the

Grand Trunk Pacific. Some parties headed westward from the head of navigation on the St. Maurice River while others, starting from points several hundred miles to the west, headed eastward. These latter parties, following the banks of streams or working across country by dead reckoning, planned to meet parties proceeding from the opposite direction. The rigorous specifications for gradients and maximum curvatures of the line frequently called for explorations extending as far as 50 miles on both sides of the axis of advance. Often a half-dozen tentative locations would be made without achieving any satisfactory conclusion. After 18 months of intensive activity 9,156 miles of surveyed line had been run but only 358 miles of this total had been accepted as representing a final determination of route.

Though a final line through a survey district might total 300 miles, yet in that section alone it would sometimes be necessary for surveyors to explore and run preliminary lines exceeding five times that distance! Thus, between Moncton and Winnipeg, a line distance of 1,800 miles, parties had to cover more than 10,000 miles of exploratory, preliminary and location surveys in order to search out the most feasible route for the railway. All distances had to be carefully measured by chain. In order to ascertain precise levels both transit and levelling instruments were employed. Every surveyor of the Grand Trunk Pacific lines was instructed to keep grades of 1:250 against eastbound traffic and 1:500 against westbound traffic. The maximum curvature permitted was 4 degrees or a radius of 1,433 feet. If any surveyor found it impossible, under special circumstances, to keep within these limitations he reported his difficulty to his superior. Only the chief engineer had discretion to depart from the standards laid down.

When all survey reports had been filed it was found that, for the greater part, the rigid specifications could be observed. It was also revealed that, in all, nearly 250 streams would have to be bridged. The first construction contracts were awarded by the Grand Trunk Pacific in April, 1906. On June 1, 1915, 'regular' train service was inaugurated between Quebec City and Superior Junction, near Sioux Lookout and about 258 miles east of Winnipeg. In November a truly regular service was established between Moncton and Quebec City.

The Western Interior

In the opening years of the 20th century Canada rode the crest of a wave of prosperity. Settlers were attracted from Europe, the United States and from eastern and central parts of Canada, by the availability of cheap land in the west. They streamed into the region beyond Winnipeg in large numbers and with this marked upsurge in population came the conviction that the one existing transcontinental railway was insufficient to meet the needs of this rapidly developing territory. Charles Melville Hays (1856-1912), a successful American railroad executive, was brought to Canada by the Grand Trunk interests to help restore its failing financial fortunes. Hays, to a considerable extent, changed the map and history of Canada before losing his life in the *Titanic* disaster. He inspired the opening up of the more northerly stretches of the fertile western country as well as a veritable empire in northern Ontario and northern Quebec as well as in north-central British Columbia. Hays prevailed upon the British owners of the Grand Trunk to build a transcontinental line through virgin territory. His bold initiative gave the Liberal government at Ottawa an opportunity to foster the construction of a coast-to-coast rail system, an achievement that promised to match, if not surpass, the building of the Canadian Pacific transcontinental under Conservative administrations. Sir Wilfrid Laurier pledged federal government support to the Grand Trunk Pacific project, subject to a condition that over the years hardened into firm party policy, namely, that no grants of free land would be made to the railway company in aid of construction. Sir Wilfrid and the Liberals were adamant on this point. They reflected, in their attitude, Canadian resolve to abandon completely a policy that had tended, in the view of the majority, to alienate far too large a proportion of the best farmlands of the nation to private corporations.

The Grand Trunk Pacific Company, a wholly-owned subsidiary of the Grand Trunk Railway Company, undertook construction of the western division of the transcontinental line "to standards not inferior to those on the main line between Montreal and Toronto". In the early stages of its railway operations 86 townsites were purchased across the western interior by an agency of the Grand Trunk Pacific. Surveyors were asked to lay out towns on a pre-determined pattern. Railway stations were to be separated by not less than seven nor more than fifteen miles. Station names, according to their initial letter, followed in alphabetical order. Thus, in travelling west from Winnipeg on the main line of the Canadian National Railways (which adopted the Grand Trunk Pacific route across the prairies) one finds in Manitoba such towns, following on after Exira, as Firdale, Gregg, Harte and Ingelow. In Saskatchewan one comes upon the successive communities of Watrous, Young and Zelma. Even today, despite the introduction during intervening years of new names and the replacement of others, it is possible for a passenger to detect considerable remnants of at least four original and distinct alphabetical arrangements of station names between Winnipeg and Edmonton.

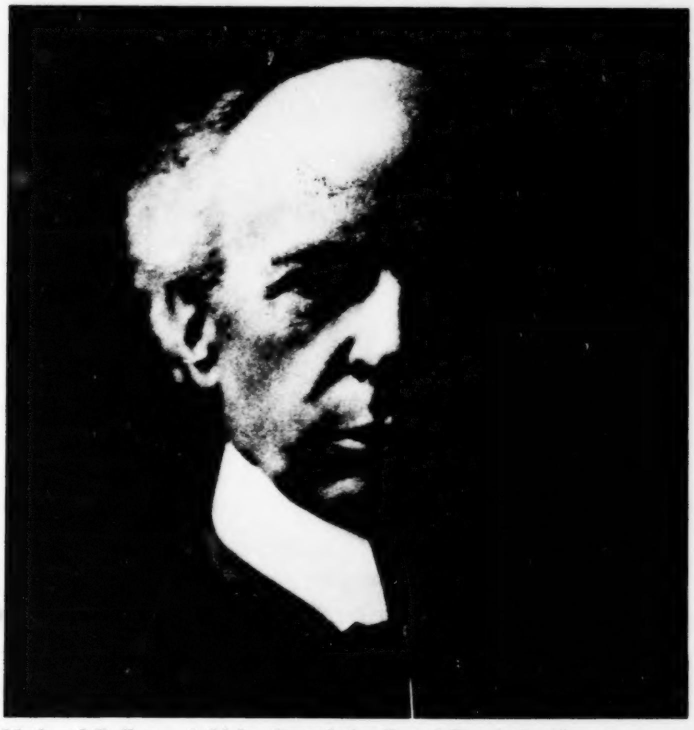

FIGURE 101
Sir Wilfrid Laurier.

A writer of this period from 1907 to 1909 has described graphically the procedure usually followed by Grand Trunk Pacific Railway townsite surveyors and engineers:

"A party of engineers rolled along the proposed line from Winnipeg to Edmonton . . .

[When it] halted, surveying instruments were brought out to determine on the map the exact spot. 'We will put a town here', said the engineer in charge. The man who held the map put a spot on the sheet. Other men made marks on the ground and thus a town was born. There was no ceremony, no one was there to applaud, no residents came to shout. The party got into their wagons and drove on for perhaps another ten miles to assist at the birth of another town just like the first . . . The main street of the town runs down to the railway station; it is 80 feet wide and no building costing less than a thousand dollars can be erected on certain parts of it."[11]

The Rocky Mountains

At Wolf Creek near Edson, Alberta, the semi-parkland begins to yield to foothill country. More than 900 miles out of Winnipeg the western horizons suggested the nearness of the Rockies. The flat prairies lay far to the east. The carefully chosen rail route ran from Winnipeg to a crossing of the South Saskatchewan River at Saskatoon, across 416 miles of fairly open plains, and then headed for Edmonton, 331 miles to the northwest. After Wolf Creek the line passed through the Athabasca River valley and then entered Yellowhead Pass to cross the Continental Divide where Sandford Fleming's 1874 bench mark could still be seen.

When viewing Rocky Mountain scenery from comfortable, not to say luxurious, railway coaches it is not easy to visualize nor comprehend the ordeals of those whose survey work made such easygoing sightseeing possible. The cutting of trial lines to permit surveyors to use their instruments involved much scrambling over windfall, and deadfall, numerous fordings of swift mountain torrents and a great deal of sliding across massive, often very slippery rocks and boulders. Food supplies frequently became depleted and a state of semi-starvation was the common lot of railway surveyors operating in this rugged terrain. The finished task conveys the illusion that finding and preparing a way for the sleek, speeding trains of the future, was fairly obvious and relatively easy. Yet all too often for every mile of actual location, 50 or 60 miles of line had to be run. The production of 180 miles of rail route from New Hazelton to Prince Rupert meant, for example, running more than 12,000 miles of trial and preliminary surveys. Every obstacle of antagonistic nature, capable of thwarting surveyors, had to be overcome. The first 100 miles of track alongside the Skeena River represent a particularly impressive tribute to surveying and construction skills, as exercised in the heart of the Cascade Mountains. For the first 53 miles the grade is virtually level. This astonishing result was achieved in a region where hopes of introducing even one mile of level trackage were invariably crushed by the constant presence of forbidding, formidable terrain. Though costs of building this stretch of line proved high, economics produced in actual railway operations fully justified the initial engineering investment.

The presence of grizzly bears, on occasion, was an additional terrifying hazard encountered in field work in the mountains. Once during surveys along the Grand Trunk Pacific in the Rockies a surveyor and his assistant had to abandon their transit very hastily in order to escape the onslaught of an infuriated grizzly. When the animal finally retreated the two men made their cautious way back to the instrument, greatly fearing that their indispensable tool had been destroyed. To their profound relief they found the transit intact on its tripod but the waterproof cover had been torn to shreds.[12]

Three years of reconnaissance surveys through 40 passes reduced the number eligible for additional examination to four, namely, Wapiti, Pine, Peace River and Yellowhead. B. B. Kelliher, a railway-building Irishman brought to Canada by Hays, enlisted some of the finest surveyors available to scour the Rockies between the 50th and 55th parallels of latitude to discover the pass possessing the best grades. Upon the basis of their reports he boldly chose the Yellowhead. Two other Grand Trunk Pacific men whose names have become legendary in the railway-building world were C. C. "Four-tenths" Van Arsdoll* and that surveyor of outstanding competence in reconnaissance work for the Grand Trunk Pacific, R. W. Jones. Van Arsdoll acquired his unique nickname as a result of his famous ultimatum to surveyors that the grade of the final route through the Rocky Mountains was not to exceed four-tenths of one per cent.

The story of Kelliher's selection of a pass for the Grand Trunk Pacific through the Rockies is enlivened by what might be described as an exercise in military-like deception. The rival Canadian Northern Railway was thrusting westward rapidly at the same time and it was the unpublicized plan of its surveyors and builders to penetrate the mountain barrier through Yellowhead Pass. The Grand Trunk Pacific board of strategy, also loathe to make widely known its preference for the same pass, permitted press and public to speculate on whether it would choose Pine Pass or Peace River Pass. To encourage such doubts and to cheerfully mislead men of the Canadian Northern, ostentatiously large but bogus survey parties were concentrated in the more northerly passes by the Grand Trunk Pacific. All the while a small, highly competent crew of Grand Trunk Pacific surveyors unobtrusively scouted Yellowhead. As soon as their plans had reached completion, had been duly filed with the federal government, and officially approved, the company made public its decision to build by way of Yellowhead Pass.

Alaskan Boundary quarrels had hurt Port Simpson's prospects of becoming the terminal point on the Pacific of the Grand Trunk Pacific. At Sir Wilfrid Laurier's request a more defensible site, in military terms, was chosen. The townsite and harbor of Prince Rupert were so named by officers of the railway company. The name of the cousin of King Charles II of England, first governor of the Hudson's Bay Company, was selected following a prize contest open to the public and conducted through the press.[13]

Before the emergence of the Canadian National Railways as a legal entity in 1918, the Canadian Northern Railway constituted a major rail system in Canada, with lines extending both east and west. This far-flung system was the creation of two Canadians possessed of great talents, energy and vision: (Sir) William Mackenzie (1849-1923) and (Sir) Donald Mann (1853-1934). In their active careers they had for many years the able assistance of David Blythe Hanna (1858-1938). Hanna, after being president of the Canadian Northern, became first president of the Canadian National Railways.

The Canadian Northern Railway had its true beginnings in January, 1896, when Mackenzie and Mann embarked on their historic partnership by purchasing the Lake Manitoba Railway and Canal Company, with Hanna acting as superintendent of the line. Three years later that line and the Winnipeg Great Northern were absorbed into the Canadian Northern Railway. Within 16 years of this merger the Canadian Northern system controlled 10,000 miles of trackage in Canada, although the total *operated* mileage was somewhat less. Thus in the span of 20 years Mackenzie and Mann, by actual construction or by a variety of business transactions (many involving intricate financing arrangements) had developed an impressive network of local lines in the western interior and elsewhere. In 1901, for example, they entered the Ontario field and by 1909 had taken over the Central Ontario Railway. In all they came to own ten railway properties in that province and an equal number in Quebec province. British Columbia also attracted their attention and enterprise.

In those buoyant years of the first decade of the 20th century Mackenzie and Mann set greater goals for themselves. With high hopes and insufficient funds they ventured into transcontinental main line competition with the Grand Trunk Pacific. This proved to be a

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*Some men named in this chapter were engineers rather than surveyors. In all probability they were civil engineers specializing in surveying activity. Laymen, witnessing their performance in the field, would naturally conclude that they were surveyors.

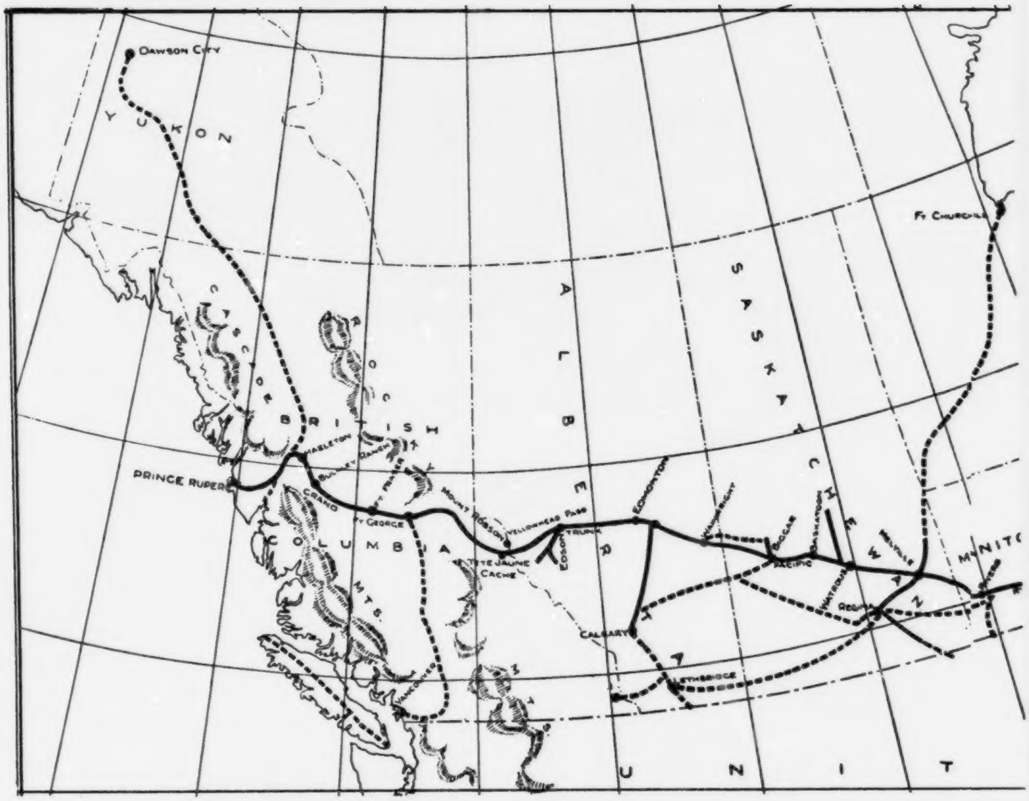
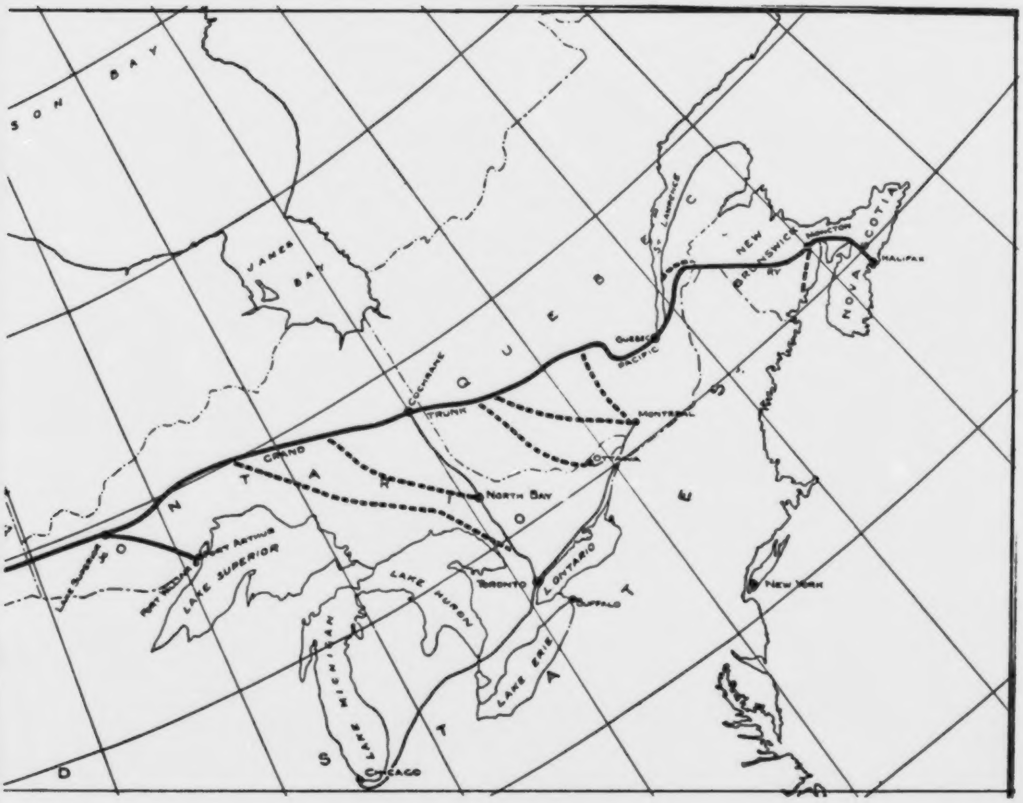

DAWSON CITY
YUKON
CASCADE
ROCKY
BRITISH
COLUMBIA
MTS.
PRINCE RUPERT
HAZELTON
BULKLEY CANYON
GRAND
FT GEORGE
MOUNT ROBSON
YELLOWHEAD PASS
TRUNK
TETE JAUNE CACHE
EDSON
VANCOUVER
ALBERTA
EDMONTON
CALGARY
LETHBRIDGE
SASKATCHEWAN
WAINWRIGHT
BIGGAR
SASKATOON
PACIFIC
WATROUS
REGINA
MELVILLE
FT CHURCHILL
MANITO
UNIT

FIGURE 102.


SON BAY
JAMES BAY
ONTARIO
QUEBEC
UNITED STATES
NEW BRUNSWICK
NOVA SCOTIA
ST. LAWRENCE
COCHRANE
GRAND
TRUNK
PACIFIC
RY
QUEBEC
MONTREAL
OTTAWA
NORTH BAY
MONCTON
HALIFAX
PORT ARTHUR
FORT WILLIAM
LAKE SUPERIOR
LAKE HURON
LAKE MICHIGAN
LAKE ERIE
L. ONTARIO
TORONTO
BUFFALO
NEW YORK
CHICAGO

Railway routes.

monumental error of judgment. In earlier days the pair had promised that for every half million of new settlers entering the western interior of Canada they would build an additional 1,000 miles of railway. This pledge had been kept. But over-expansion of facilities and changing world conditions generated a sudden, swift decline in their fortunes. The outbreak of the First World War in August, 1914, dealt a crippling blow at the imposing transportation structure they had so valiantly erected. In terms of financial health the giant had all too quickly lapsed into a chronic invalid. On the conclusion of hostilities in Europe the inevitable occurred and the Canadian Northern, along with the National Transcontinental and some smaller lines, became part of the government-owned Canadian National Railways.[14]

Mackenzie and Mann, however, had made an immense contribution to the upbuilding of the western interior and in meeting the railway needs of the region in the first decade of the 20th century when population on the prairies tripled and a five-fold increase took place in occupied lands. The numerous surveys conducted under their auspices in the development of the Canadian Northern Railway must rank in significance with those of the Canadian Pacific, Grand Trunk Pacific and Intercolonial in helping to shape Canada's progress toward a more mature nationhood.

The story of surveying on local and branch lines in Canada would easily fill an entire book. For the purpose of this chapter only a few examples have been selected, almost at random, as representative of efforts in this field of endeavor. In 1878, for instance, a charter was granted authorizing the Nelson Valley Railway Company to build and operate a line from the international border (Manitoba) to Churchill on Hudson Bay. The plan of the promoters was to direct northward to tidewater the grain and cattle products of the Red River Valley. In the following year G. A. Bayne of Winnipeg, a man experienced in railway construction and who was both a Dominion land surveyor and a Manitoba land surveyor, was asked by the company to make a preliminary report advising on the feasibility of a route.

Bayne chose a plot of land at the western outlet of Playgreen Lake as the southern terminus of the proposed railway. He made a traverse as well to determine at what point the line should cross the Saskatchewan River at Grand Rapids. In 1880 Bayne was asked to make surveys northward and to start clearing the right-of-way. That season, with an assistant and some Indians, Bayne made a trial location of about 60 miles. Two years later, with 8 Indians, and equipped with a pocket compass and aneroid barometer, Bayne followed the west slope of the Nelson River watershed, looking for good crossings of streams. He established food caches about 100 miles apart. In mid-July, 1882, when the party reached Fort Churchill, they found all flags flying in their honor and the whole population of the place gathered on the landing as a salute of welcome was fired. During a fortnight's stay at Churchill, and with the aid of local Indians, Bayne made a survey of the harbor, taking soundings. His Norway House Indians declined to venture on the strange 'big waters'. After many stirring adventures Bayne and his crew returned to their starting point. He was able to present a report of considerable value. But in 1883 the Nelson Valley Railway Company was sold to the Hudson Bay Railway Company.[15]

In the Far North impressive gold finds in the Klondike area spurred action in supplying rail connections between Pacific tidewater and the Yukon Territory. Thus in May, 1898, surveyors faced the necessity of finding, without delay, a route for a line through 40 miles of forbidding mountain wilderness. Five survey parties were sent by the White Pass and Yukon Railway into the region. For weeks these surveyors were lost to sight. In the result, however, rail reconnaissance surveys were completed on both sides of the Skagway River and of the White Pass as far as Summit. The direct-line distance from seaboard to Summit was 14 miles. Making the most of the contours of the mountainsides in order to 'gain distance', that is, to obtain easier gradients at the cost of increased mileage, it was possible to build 20 miles of line. The railway was constructed from sections of each of the five routes surveyed. Acquisition of knowledge in subsequent years revealed that the route actually selected was the best that could have been chosen.

In these surveys John Hislop, with the title of Assistant Chief Engineer, was in direct charge of operations. He served under Chief Engineer Erastus Corning Hawkins. Both were Americans. Hislop seemed everywhere at once, encouraging and directing work in the field. In addition to keeping in touch with his five camps, Hislop had the responsibility of making certain that White Pass was, in fact, the logical gateway to the Yukon. The prevalence of rumors and the propaganda of native folklore suggesting that other and much better passes existed, added to his burden. In order to satisfy himself that other usable passes were purely mythical Hislop set forth on foot and covered about 50 miles of rugged terrain, including formidable swamps and snowfields before arriving at his destination utterly exhausted, his clothes in tatters and his feet, almost shoeless, torn and bleeding.

In Central Canada railways appeared in considerable numbers. Towards the end of the 19th century interest was mounting in government and private circles concerning the possibilities of opening up northern Ontario to settlement and development. Various proposals for providing transportation finally crystallized into a plan to build a line of railway directly into the north of the province from Lake Nipissing. Farming prospects in the clay belt of the region as well as possibilities for considerable lumbering activity, spurred action on this project.

In 1900 the legislature of Ontario provided funds for preliminary survey work on the proposed line. W. B. Russell was instructed to push ahead with the task. Operations were started in May of the following year. On May 10, 1902, after the Temiskaming and Northern Ontario Railway Act had passed, the first sod was turned at North Bay. Despite stretches of exceedingly difficult terrain, rail surveys and construction of the line continued at a rapid pace. In 1903, near Mile 103, silver and cobalt deposits were discovered. Within a short period the area became the immensely rich Cobalt mining field. By the end of 1904 Ontario Northern rails had reached a point just south of the present site of Englehart. Three years later the line was extended to the Cochrane area to effect a junction with the National Transcontinental Railway, thrusting westward from Quebec City. In 1911 the Porcupine gold mining area was linked by rail to the main line. In later years, up to the outbreak of the First World War, new branch lines were built or acquired to connect the main route with developing mining and pulp industries. The original route of the Ontario Northern Railway was selected by G. A. Mountain, Chief Engineer of the Canada Atlantic Railway, called in as a consultant. Initial surveys commenced under W. F. Russell of the Ontario Northern in 1901. In the following year Russell became Chief Engineer of the line.[16]

In the west the Alberta legislature of 1907 chartered the Edmonton, Dunvegan and British Columbia Railway Company to build from Edmonton to Dunvegan and thence to Fort George. After surveys had been completed, construction began in 1912 and four years later reached Spirit River, a distance from Edmonton of 357.8 miles but still some 25 miles from Dunvegan. In 1916 a branch line was extended 50 miles from Rycroft to Grande Prairie. The Alberta and Great Waterways Railway was chartered in 1909 to build from Edmonton to Fort McMurray by way of Lac la Biche. In 1913 J. D. McArthur, building the Edmonton, Dunvegan and British Columbia Railway, obtained control of the Alberta and Great Waterways property. Construction began at Carbondale, near Edmonton, in 1914 and by July, 1916, the Alberta and Great Waterways line had reached Lac la Biche. These two railways, together with two lesser lines, namely the Central Canada Railway and the Pembina Valley Railway, were all merged into the Northern Alberta Railways. Engineering records and location plans, to a large extent, were destroyed by fire. Information is therefore scanty about details of early surveying but it is known that W. R. Smith did nearly all location work and signed most of the plans of the Alberta and Great Waterways Railway and of the Central Canada Railway. He had some assistance from such Alberta land surveyors as Jean Léon Coté, A. J. Tremblay and C. C. Fairchild. Thomas Turnbull performed much of the location work for the Edmonton, Dunvegan and British Columbia Railway. Only one plan, signed by a surveyor, has been found in this regard and the sheet bears the name of the Alberta land surveyor, A. E. Farncomb.

In summary it may be said that records of reconnaissance and other surveys for the Grand Trunk Pacific Railway can be taken as typical of railway surveying generally in Canada between 1867 and the First World War. The reconnaissance type of survey was valuable in furnishing information on the topography of the country to be crossed by rail, as well as providing guidance on the main direction the line should take in order to minimize gradients, curvature, and earthwork. This initial scouting of the terrain was sometimes carried out by the chief engineer or surveyor, accompanied by several Indians who were familiar with the land. In those early times existing maps of the region to be investigated were too often unreliable or too general in character to be of much use. Accordingly the country traversed would be mapped by the surveyor to show feasible routes. In this work aneroid barometers as well as compasses were the principal instruments employed.

Preliminary surveys followed such pathfinding expeditions. These more detailed examinations served to narrow the range of route selection. A third stage, location surveys, were even more precise and these determined, with a considerable degree of finality, the course of the railway line. Surveyors and engineers would thus strive to determine the specific path that would best answer the demands of practicality and economy of construction. A location survey was never so final, however, that it could not be revised, often at the last moment in order to improve the economic balancing of grades, curvature, earthwork, bridges and culverts.

Railway surveyors had to be men of exceptional calibre, possessed of first-class physical and mental fitness, to function effectively through prolonged periods of exacting toil in the lonely primeval forestland, remote from civilization. The brooding silences of the apparently endless woods, the constant hazards attending their tasks, and the demoralizing sense of isolation tested human endurance to the utmost. Some of the ordeals encountered included the climbing of successive ridges, plunging into nameless valleys, wading through swamp and muskeg, crossing treacherous, swiftly flowing rivers, detouring around lakes and struggling over interminable deadfall. In the pitiless cold of winter and in the sweltering heat of summer, surveyors often had to hack their lines through dense undergrowth. Yet the strange elation that comes with the subjection of a formidable wilderness to the works of man, carried surveyors ever forward to ultimate triumph over all obstacles.

Survey parties, preparing the way for rail lines, usually consisted of the party chief, an assistant surveyor with transit, a leveller, a topographer and a draughtsman, accompanied by chainmen, picketmen and axemen. The topographer prepared a contour plan covering up to 500 feet on both sides of the preliminary line traced out and laid down by the remainder of the survey party. Otherwise splendid men were sometimes dropped from survey crews because they were found unsuited to running a line across wilderness country with sufficient speed. This gruelling work demanded men of good physique and possessing a congenial disposition. Acute hardships, even privations, combined with periods of highly strenuous exertions featured these surveys in the wilds, especially in the striking of camp in wintertime to move on to another place. Often the entire party had to take part in cutting a roadway of sorts through dense timber to reach their next base of operations. All baggage had to be back-packed or hauled in sleighs or toboggans built by the men themselves. On occasion there were drownings as men plunged through false or shell ice on lakes and rivers. Desertions of canoemen and of packers were not uncommon in summer. Clouds of black flies and mosquitoes made life miserable in warm weather.

The task of supplying survey parties scattered across more than 1,800 miles between Edmonton and Winnipeg required great resolution and remarkable organization. Hugh Lumsden is the man commonly credited with the planning and maintenance of these all-important supply services. By directing the cutting of roads into timbered areas where no previous paths existed, Lumsden was able to establish food reserve depots at strategic points. Each depot was placed in charge of a keeper and his assistant. Secondary depots were also provided, usually at eight- or ten-mile intervals along the lines of communication. From these auxiliary food caches, containing as a rule upwards of five tons of provisions, survey parties replenished their supplies in the field.

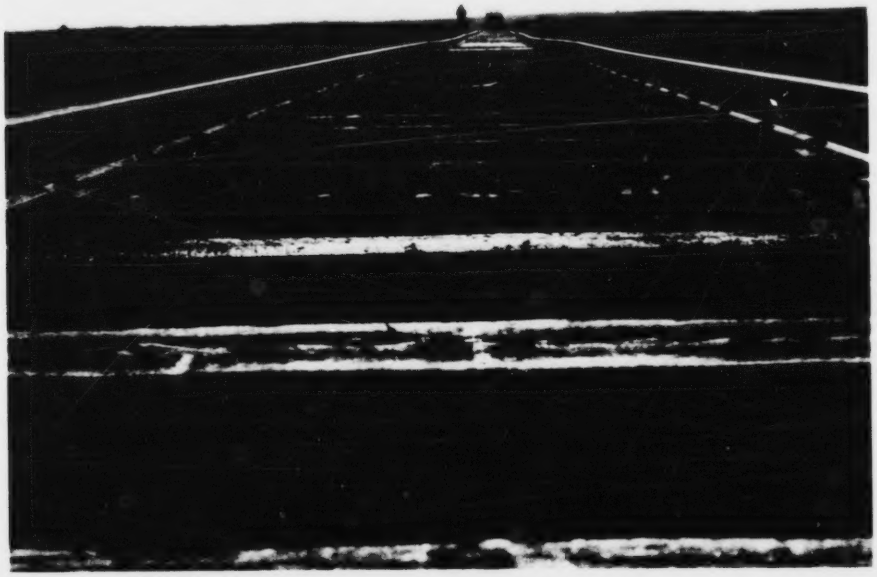
Food in the subsidiary depots consisted, for the most part, of staples such as pork and beans, oatmeal, flour and bacon. Supplementing this rather austere, if nourishing, diet were such delicacies as prunes, apricots, sugar, condensed milk, tea, coffee, butter, and lime juice. Variety, or the illusion of variety, in this stringent fare depended upon the skill and ingenuity of the cook of the party. These shipped-in foodstuffs were also increased and varied by such fresh meat as could be obtained by catching fish and hunting wild fowl and game.

Food caches were constantly in danger of raids by bears and by other wild animals. Nor were these supplies ever free from the much dreaded menace in timber country, the forest fire. On one occasion, near Lake Abitibi, flames threatened destruction of a main food depot. The keeper and his assistant fought valiantly for two days and nights in a grim effort to save their precious stores. Just as these appeared to be doomed a transport party arrived on the scene. Quickly summoning his men from the field the chief of district surveys directed his tiny force in a successful fight to save the provisions. More than once in their field operations railway surveyors found themselves directly in the path of a swiftly advancing, roaring inferno. There were numerous narrow escapes from fiery death.

There was no interruption of survey work because of winter. Often surveyors and their assistants waded hipdeep in uncrusted snow in extremely low temperatures, doing what they could to fend off frostbite and snow-blindness. Surveying between Lakes Abitibi, Nipigon and Winnipeg proved particularly trying under such circumstances. Medical doctors, allotted to the various survey districts, toured among the parties, helping to maintain their physical fitness. Scurvy, frostbite and appendicitis attacks were the most common emergencies requiring skilled attention.

As location surveys continued, the selection of a possible route for the rail line proceeded and a profile of the country being crossed was drawn in the field precisely to scale. Full information on the topography was noted on maps so that a reasonable estimate of construction costs could be made by experts. Surveyors also were required to report on the economic value of the country in which they were working, giving their judgment as to its future capacity to contribute revenue to railway operation. In later years and in more settled parts of the country, location surveys were followed by right-of-way surveys by means of which properties required by the railway for its operations were concisely defined. In turn these surveys were followed by construction surveys, marking out the particular strip of ground on which tracks were to be laid and setting stakes to control earthwork activities. The track centreline was pegged out by stakes placed 100 feet apart in a line along the centre of the cleared path. A fast-travelling revision party always worked a few miles ahead of construction in hopes that at the very last moment an improved location for the line could be found.

The appearance of railways in Canada brought about profound economic changes in this nation and made possible the rapid settlement and development of the western provinces in the period between Confederation and the First World War. Railways helped to open up mineral-rich areas in northern Quebec and northern Ontario. Railway-building accomplishments inspired a new approach in the realm of public finance and provided the foundation of a new industrial era. Steam power replaced water power in mills producing Canadian lumber and flour. Rail routes heralded the growth of manufacturing enterprise in British North America and signalled the beginnings of a tariff system designed to protect Canadian industries. By multiplying business and social contacts between peoples of the provinces the railways served to increase mutual understanding and joint action. In this way a spirit of constructive nationalism was encouraged and given new scope. But without the achievements of railway surveyors the pace of progress in all these important developments would have been much slower and much less significant. The value of the mass of information gathered and reported by them is beyond calculation. In the years following Confederation Canadians owed to these well-trained observers and measurers the greater part of the sound, reliable knowledge of natural resources that proved indispensable to the prosperity and general advancement of the new nation.



14

MILITARY SURVEYING AND MAPPING IN CANADA 1867-1918

"If you look in the maps . . ."
King Henry V, Act 4, Sc. 7

For nearly a generation following Confederation military surveying and mapping in Canada languished. The Royal Engineers, in earlier years of the 19th century, had produced a few useful but unrelated, large-scale topographic maps of localities in the vicinity of garrison towns in this country. Kingston, one of the fortified places, is described in the diary of a Canadian army officer, as the town appeared to him in 1813:

"Kingston is divided in two portions by a central square, used as a parade ground by the troops. There is also a market building and, opposite it, the Anglican Church, both are of wood. To the right of the square, the Court House and hotel, both of stone and two stories high. The latter is an excellent house in every respect, but the former is built in bad taste. The town of Kingston is the capital of the Midland District. The houses are built mostly of wood."[1]

When garrison forces were withdrawn to Great Britain activity in military surveys in this country dwindled. Between 1894 and 1902 the only noteworthy topographic mapping accomplished in Canada along military lines was carried out by cadets of Royal Military College, Kingston. On June 1, 1876, the college was formally opened by Prime Minister Alexander Mackenzie who, as stonemason in charge, had helped to build the Martello Tower at Fort Frederick in the 1840s. This was one of the units in a system of fortifications constructed to protect the lake entrance of the Rideau Canal.

Eighteen freshman cadets attended the opening ceremonies. Following graduation this historic Class of 1880 became affectionately and respectfully known as the "Old Eighteen". Textbooks of the cadets in those days included Robert's *Military Surveying*, Deville's *Examples of Astronomical and Geodetic Calculations* and Gillespie's *Land Surveying*. In 1882 a course entitled "Surveying: Military Topography and Reconnaissance" was listed as a major subject on the college curriculum. This course included a study of the principles and uses of the plane table and of levelling procedures.

A distinguished member of the college staff in the 1890s was Capt. Arthur Hamilton Lee

(1868-1947) who later became Lord Lee of Fareham and a First Lord of the Admiralty. From 1893 to 1898 he was Professor of Strategy and Tactics with the rank of captain. Robert Carr Harris was the first civilian professor to lecture at the college in civil engineering and architecture. After 18 years on the staff of Royal Military College he left to become the first Professor of Engineering at Queen's University. Capt. C. Russell Brown, R.E., was also a Professor of Surveying at Royal Military College before the turn of the century. His daughter 'Anna Russell' achieved international fame on the concert stage as a gifted comedienne.

The years from 1894 to 1902, in terms of Canadian military surveying and mapping, are generally known as the Reconnaissance Survey period. Much of this type of map making in those years was performed by Royal Military College senior cadets as part of their regular summer training. In this way military survey work in Canada was kept alive during that span of time. There is record of a map of part of the Eastern Townships "executed by Graduates of Royal Military College under the superintendence of Captain A. H. Lee, Instructor in Topography, 1894".[2]

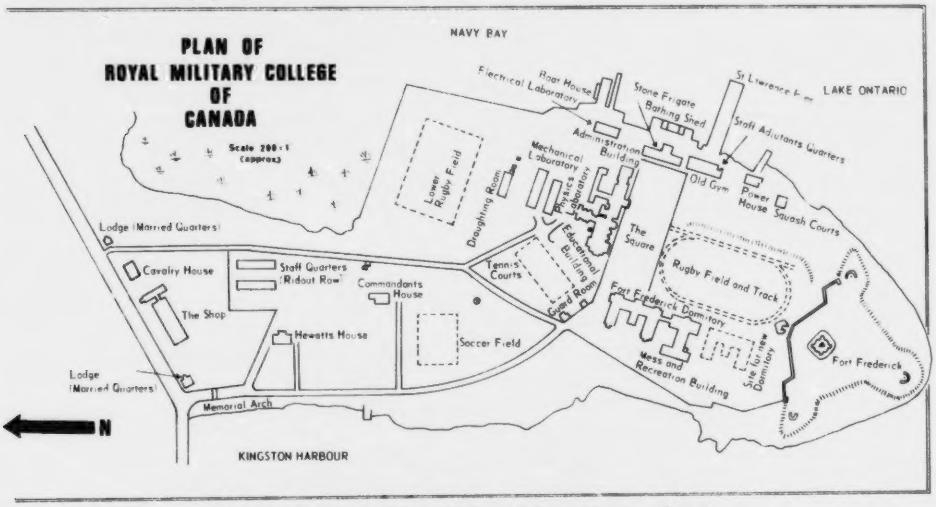

PLAN OF
ROYAL MILITARY COLLEGE
OF
CANADA
Scale 200:1
(approx)
NAVY BAY
LAKE ONTARIO
KINGSTON HARBOUR
N
Lodge (Married Quarters)
Cavalry House
The Shop
Lodge (Married Quarters)
Memorial Arch
Staff Quarters (Ridout Row)
Commandants House
Hewetts House
Soccer Field
Lower Rugby Field
Draughting Room
Tennis Courts
Electrical Laboratory
Boat House
Administration Building
Mechanical Laboratory
Physics Laboratory
Educational Building
Guard Room
The Square
Stone Frigate
Bathing Shed
St Lawrence Fort
Staff Adjutants Quarters
Old Gym
Power House
Squash Courts
Rugby Field and Track
Fort Frederick Dormitory
Mess and Recreation Building
Site for new Dormitory
Fort Frederick

FIGURE 104. Plan of Royal Military College, Kingston, Ontario.

These none-too-accurate, uncontoured maps resulted from exercises in rapid sketching in the field rather than from any professional skill. In any event, in the absence of any system of primary control, the production of military maps in this country of a high standard of accuracy was quite impossible. The college Commandant reported, with reference to the year 1899, that a reconnaissance survey had been completed that summer near Toronto and London and that about "850 square miles were added to the work already done". In 1901 the cadet summer party surveyed and mapped in the vicinity of Magog, Quebec, and in the following season similar work was resumed in western Ontario. Two officers of the permanent militia of Canada accompanied the cadets on some of these projects.

In 1903 the General Officer Commanding Canadian Militia, Major General Lord Dundonald, recommended that an Intelligence Department be created within Militia and Defence, to consist of an Information Branch and a Mapping Branch. On July 1 the organization came into existence.[3] Under the command of Lieut.-Colonel W. A. C. Denny, as Director General, the original staff of the Department consisted of three captains, two non-commissioned officers from the Royal Engineers and a staff sergeant from the Canadian permanent force. Two of the three captains were graduates of Royal Military College, namely, A. Clyde Caldwell and William Beaumont Anderson (later Major General Anderson). It was Anderson's special responsibility to improve Canadian military maps. The duties of the new organization included surveying, draughting, map production, correction of published maps and the preparation of skeleton maps for use in field work.

In a well-organized, comprehensive report dated December 30, 1903, Major E. H. Hills, C.M.G. of the Royal Engineers and head of the Topographical Section of the British War Office, and published by the latter, emphasized the need and importance of geodetic surveys in Canada. Major Hills had been instructed to report to Sir Percy Lake, Chief of the General Staff of Canada, on the desirability of a military survey of Canada. The major, however, approached his task on a much broader basis, apparently on the assumption that resulting maps ought to be of value for all purposes. His report fell mainly into three sections. In the first, the value of good maps to a nation was described; second, existing survey work in Canada was summarized and judged inefficient and costly; third, the course which a systematic survey of Canada should follow was outlined. Generally, Major Hills recommended a topographical survey of Canada, stating that it was urgently required for military, administrative and engineering purposes. He advocated the establishment of a survey department to cost $75,000 annually and which would complete the mapping of 7,500 square miles of land on a scale of one-half inch to the mile. Such a map of all Canada would, the major pointed out, meet all reasonable military requirements. In war, he stated, accurate maps are a vital necessity to convey information on the nature of the country, means of communication, water supplies, natural resources generally, and for planning general strategy.

Militia headquarters, in the years prior to the establishment of the Intelligence Department, adopted, in the main, the policies followed by the British Army in Canada—certain relatively limited areas would be surveyed by competent engineer officers and other areas were made the subject of field sketching. At first mapping was done on sketch boards with the aid of prismatic compasses. Control, such as it was, came from township plans, railway surveys and the shorelines of marine charts. Before long, however, systematic horizontal and vertical control work commenced. Mapping began on a scale of one mile to the inch, with contour intervals of 25 feet. In the report of the Militia Council for 1905 it is noted that "transit and level parties have run 1,100 and 1,300 miles of line respectively" and that "the topographers have completed 1,775 square miles of accurate survey . . .". H. C. Cranston was taken on staff in July, 1905, and during the formative years of this survey organization was its only draughtsman. He had served with a topographic unit in the Boxer Rebellion in China and was familiar with field draughting and mule-pack printing-press techniques.

M. F. Phelan joined the Mapping Branch as a transitman in September, 1905. In the following year he assumed charge of horizontal control. Phelan has described conditions of his acceptance by Capt. Anderson, who assured him that "employment would last through the winter unless higher authority intervened. The party would consist in all of five men, running transit lines through parts of Quebec and Ontario. Accommodation at hotels, farmhouses, anywhere, would be the party's responsibility; each person paying his own expenses out of his salary . . . $110 a month for the chief, $75 for each of the other four. Costs of railway transportation and limited livery would be met by the government."[4] Under this arrangement Phelan began a term of service of nearly 38 years on army surveys.

In the 1904 season field parties were sent to the Niagara Peninsula on transit traverses for horizontal control, spirit levelling for vertical control. Results of this work were compiled on one general map from which sheets of Niagara, Welland, Grimsby and adjoining areas were produced. In September of the following year work commenced on a transit and chain

FIGURE 105. Capt. W. B. Anderson.

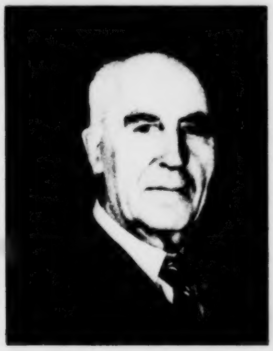


FIGURE 106. M. F. Phelan.

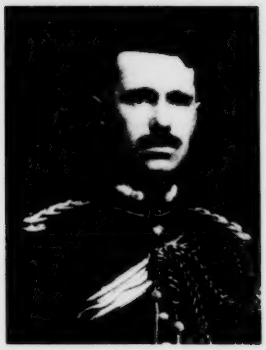


FIGURE 107. Capt. T. V. Anderson.

traverse line from Ottawa to Montreal. Near the end of December, 1905, the survey line was completed to the McGill University Observatory. For the remainder of the winter this survey party worked between Montreal and Kingston.

Phelan's comments at this stage of development in the unit's growth are interesting: "Niagara was the first map sheet to appear . . . It was soon followed by the Ottawa sheet. The chief, W. B. [Anderson], was very pleased to see these first fruits of his labours, detailed contoured maps, the first of their kind in Canada, emanating from a systematic survey that had reasonable hope for continuance and growth. The maps were artistic and well printed. The roads, with features beside them, were quite accurately placed. Any considerable distances from the roads, especially in wooded, rough country, the contouring, etc., was frequently faulty. After the fixing of geodetic points by the Geodetic Survey of Canada at a later date, it was sometimes slightly embarrassing to find that a plotted point was on the side of a hill rather than at its top. The vagaries of water courses beyond open country could not be relied on, but on the whole there was little adverse criticism by those who had occasion to use the sheets."[5]

Sir Percy Lake, as first Chief of the General Staff of Canada, was quick to recognize the vital importance to national defence of accurate, properly contoured maps. In November, 1905, he urged upon the Militia Council adoption of an arrangement with the British War Office whereby up to six Royal Engineers, trained in topography, would be loaned to the Department of Militia and Defence during summer seasons in order to assist with Canadian military surveying and mapping. On November 30, 1905, the Militia Council approved the proposal and the loan program went into effect in the season of 1906. In the same year the Mapping Branch became the Survey Division and continued to function under the Chief of the General Staff. Capt. W. B. Anderson was appointed Assistant Director of the new division and this title persisted for the next quarter-century. Nearly half a century later the term 'Director' was adopted to denote the head of this survey organization.

In the field season of 1906 military survey parties worked in western Ontario and from there went to the Petawawa area where land had been acquired for army training. There they joined several topographers working under Lieut. S. H. Osler, engaged in gathering mapping information on the locality. Within the five-year period following his appointment Capt. Anderson organized and provided, on a methodical basis, a framework of traverses and instrumental levels on which was based detailed mapping of approximately 10,000 square miles. In these tasks he had the assistance of Lieuts. G. B. Wright, S. H. Osler, L. G. Van Tuyl and R. W. Stephenson, all graduates of Royal Military College.

During the 8-year period when non-commissioned officers and men of the Corps of Royal Engineers were on loan to Canada, more than 20,000 square miles in the more settled, central part of this country were completely surveyed. A total of 66 sheets of mapping, much of it on the scale of a mile to the inch, was compiled. Half of these sheets had been published by 1913. The Royal Engineers, along with Canadian soldiers and civil servants, worked mainly in the Eastern Townships and in western Ontario. Some work was performed as well in the vicinity of Montreal, Toronto, Ottawa and Kingston, also between Hamilton and Detroit, including the Niagara district.[6] The Royal Engineers at all times observed high standards of craftsmanship in mapping activities. Their work was meticulously done in the British military tradition and was of a type seldom seen in Canada up to that time. The deliberate pace at which they worked would have produced serious delays had they been employed on land settlement surveys in the western interior. Such surveys had to be performed with the greatest possible accuracy consistent with utmost speed. Too often, to be true, the former suffered for the sake of the latter. The accomplishments of the Royal Engineers personnel on loan to Canada from 1906 to 1914 helped to bring about a fundamental change in topographic mapping in this country by emphasizing quality of craftsmanship rather than quantity of output.

In 1908 Capt. G. B. Wright succeeded Capt. W. B. Anderson and two years later Wright was followed, in turn, by a brother of the first Assistant Director. Capt. T. V. Anderson (later Major General Anderson and Chief of General Staff) remained in that capacity until the outbreak of the First World War. Soon after his appointment to head the Survey Division, Capt. T. V. Anderson moved to add a lithographic section to its existing facilities. His goal was reached in 1913 with the establishment in Ottawa of a complete photo-mechanical and lithographic section. Accordingly there was no longer any need to forward manuscript maps to the Ordnance Survey in England for reproduction.[7] During a period when government funds for such a purpose were exceedingly scarce, this important expansion of services represented an administrative achievement of some magnitude. In addition to finding money for the purchase of necessary equipment it was also essential to get permission to obtain from England four well-qualified operators for the new plant, men who would become permanent officials in the civil service of Canada. The success of this undertaking was all the more remarkable in that there was, about this time, a gradual trend away from the practice of borrowing Royal Engineers to help in the prosecution of Canadian military surveys. In fact, by 1914, the arrangement had largely lapsed.

With the establishment of the Survey Division on a sound footing its duties became more clear-cut and may be summarized as follows:

1. The preparation of contoured maps on a scale of one mile to the inch.
2. The training of members of the Royal Canadian Engineers in topographic mapping and draughting work and lithography. It was intended that these trained men would act also as instructors in these subjects with other units of the permanent and reserve forces.
3. The preparation of large-scale maps for troop manoeuvres and for the guidance of artillery units and the defence of Canada generally.
4. The provision of special intelligence maps of specified areas.

On November 15, 1913, the Survey Division was rather arbitrarily transferred to the Master General of the Ordnance. After a nine-year period "in exile" the division was restored to its former place under the Chief of the General Staff. Capt. T. V. Anderson was succeeded by Capt. Philip de L. D. Passy, who served as Assistant Director from 1914 to 1916. His successor in office was Major J. B. Cochrane who assumed the duties, if not the title, of Assistant Director, continuing to function as head of the survey organization until March, 1929.

During the years from its inception to the outbreak of the First World War and, in fact, for a number of years following, the Survey Division remained financially undernourished. But it was becoming increasingly clear to civilian authorities that any country that failed to provide its armed services with good maps and charts deprived them of vitally important information.

After the declaration of war in 1914 the Survey Division was called upon to prepare large-scale plans for defence purposes on the Atlantic and Pacific coasts, the fixing of gun positions and related assignments.[8] Although survey units, as such, did not form part of any Canadian expeditionary force until the closing stages of the conflict, surveying naturally entered into activities of the Corps of Canadian Railway Troops serving overseas. This Corps, numbering nearly 16,000 by 1918, constructed and maintained railway lines of all gauges and was responsible for the bulk of light railway construction behind all five British armies in France.

Lieut. James H. McKnight, a Dominion land surveyor who enlisted in the Railway Troops, reported on survey work involved in the Somme offensive in 1916:

"It was found that for satisfactory work a survey had to be made and levels taken. Conditions under which this work was done were at times more trying than any previous survey I was ever on . . . The work was plotted and maps printed showing the location of all [railway] lines, with other information. The work naturally fell to the lot of the Dominion land surveyor together with supervising of grading."[9]

In the concluding months of the First World War a relatively minor occurrence within the Canadian army organization had a significant bearing on the future growth of Canadian military surveys. On May 14, 1918, formation of the Canadian Corps Survey Section was authorized. Capt. W. R. Flewin, C.E., was placed in command. The Section worked closely with the 1st and 5th Field Survey Battalions of the Royal Engineers and its duties consisted mainly of flash-spotting and accurate fixing of enemy battery positions. In addition a field triangulation party located Canadian guns and reference points in their vicinity as well as producing artillery maps, on stable bases and with azimuth arcs, for map firing purposes. A headquarters unit of the Section prepared special operation maps, barrage sheets and related cartography for reproduction prior to offensive operations. During the concluding phases of the war in France in 1918 the Survey Section also supplied large photographic mosaics, complete with map grids, for use in Canadian attacks at Amiens, Arras, Canal du Nord, Cambrai, Valenciennes, and in the advance on Mons. These activities laid the foundation for the development in subsequent years of Canadian artillery survey units.

By 1914 there were several agencies of the federal government producing topographic maps, including the Survey Division of the army. Each of these organizations selected a type of mapping considered the best for its particular purposes. Agreement did not exist on the mode of projection, the range and type of scales, or the patterns of grid or sheet lines to be used. There was a special lack of uniformity of practice concerning the mode of map projection. The problem of representing a sphere upon a plane surface does not lend itself to a complete or perfect solution. Man has attempted solutions by practising the art of projection in relation to map and chart construction. The classes of map projections thus developed are not mutually exclusive. Nevertheless certain class names, for convenience, are used in practice. Each principal attempt at a workable projection has some particular merit.[10] At least three types of projection were being employed in Canadian mapping, at the time, for large- and medium-scale cartography, namely Lambert's Conical Orthomorphic, the Transverse Mercator, and the Polyconic.

Soon after the First World War began it became obvious that maps at the disposal of Allied armies were defective from the military point of view. Lack of accuracy, difficulties in fitting separate sheets together properly, and a lack of precise grids for artillery purposes were some of the cartographic shortcomings. A general revision of maps commenced during progress of the fighting. Certain principles of map making were considered fundamental to the work of revision. These same principles were to prove of basic importance to the success of an organized system of national mapping in Canada, namely, applications of the most suitable map projection, scales and grid patterns. In addition to the need for proper selection and unification in these fields, greater attention would need to be given to the best possible use of colors and the representation of relief.

Experiences of Canadian soldiers in close contact with European mapping practices and products, proved salutary. On their return to this country they advocated a new approach to Canadian mapping problems. One of the army officers who gave leadership in this movement was Major Douglas H. Nelles, whose pre-war geodetic survey work in the Yukon Territory has been mentioned. Nelles strongly pressed for standardization of maps of Canada.[11] There was a steadily growing realization of the need for a National Topographic System of maps of Canada.

In 1922, following the formation of the Board of Topographical Surveys and Maps under terms of Order in Council P.C. 540, dated March 8, the board chairman, Deville, travelled to Europe to discuss Canadian map-making policies with British and French authorities. The British War Office, in the previous year, had been asked by Ottawa to advise upon a suitable mode of projection for Canadian military mapping. The War Office had recommended the same projection as that agreed upon by the Allies in the course of the First World War, namely, Lambert's Conical Orthomorphic. Deville, keeping in view the need for a projection usable in a National Topographic System, was not impressed by the British recommendation as it involved a departure of grid lines at the east and west limits of the country as a whole of about 27 degrees away from north. The magnitude of this departure, Deville felt, was unacceptable for general use in Canada. As a result of his discussions and in the wake of much thought on the subject Deville conceived the idea of dividing the map of Canada into lunes*, using the Transverse Mercator, also known as the Gauss Conformal projection. By restricting the lunes to 6 or 8 degrees in width, the grid lines did not, in any case, depart from the true north by more than a few degrees. Canada, after considerable experimentation and following a number of false starts on projection policy, finally settled on the 6-degree-lune Transverse Mercator projection for its topographical maps.

As early as 1899 the use of cameras in balloon surveying for military purposes had been the subject of serious consideration by Surveyor General Deville. His comments, contained in the concluding pages of his book, *Photographic Surveying*, may have been inspired, in part, by pioneer experiments carried out sixteen years previously in Nova Scotia by a British army officer. In 1883 Capt. Henry Elsdale, R.E., delved into the realm of aerial photography by sending aloft small balloons carrying automatic cameras. In this manner he obtained photographs of barracks in the vicinity of Citadel Hill, Halifax, from an altitude of 4,500 feet. On top of his primitive camera six photographic plates had been placed, resting on one another with the prepared surfaces facing downward. A clockwork mechanism was tripped by the operator on the ground.[12]

"The great difficulty in balloon surveying", Deville pointed out, "will be to determine the trace of the vertical of the station on the picture plane, or the foot of the station on the ground plan . . . The oscillations of the balloon prevent the use of any kind of level inside of the camera and instrumental measurements of angles are open to the same objection . . . Balloon surveying would only be adapted to military purposes, although the advocates of the process are confident that it will eventually take the place of all other surveying methods."

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*Parts of a plane or spherical surface bounded by two arcs intersecting at the poles.

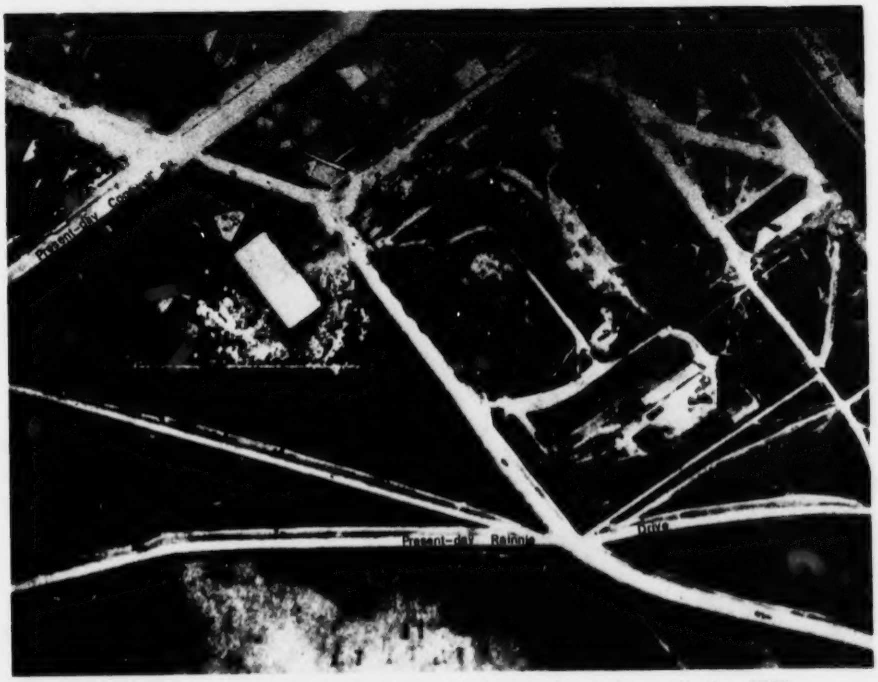

FIGURE 108. Earliest recorded air photograph in Canada, from balloon at Halifax, 1883.

A constructive development of revolutionary significance for civilian surveying and mapping in Canada resulted from the ingenious use of cameras mounted on scouting planes during the First World War. The first practical application of air photography to mapping in Canada began in 1918. Four important factors combined to make this possible: the availability of improved cameras, suitable planes, trained men and an organization capable of providing support for air-mapping projects. A number of planes were turned over by the Canadian government for these experimental peacetime uses. Experienced flying officers, fresh from triumphs overseas, formed the nucleus of the new service. Among these pilots were enthusiastic young surveyors, quite eager to face the personal risks involved in order to have an active share in a trail-breaking venture and to help advance knowledge of Canada's less accessible areas. An Air Board, first formed in June, 1919, was reconstituted a year later. Several of its members, including Surveyor General Deville, were keenly interested in the unfolding possibilities of mapping from the air and the Board gave its full backing to this promising enterprise.

The history of surveying and mapping, during the period reviewed in this chapter, would be incomplete without reference in some detail to notable work performed in these fields by graduates of Canada's Royal Military College. At least five members of the "Old Eighteen" became prominent in railway engineering in this country, including related survey work.

FIGURE 109. Royal Military College from the air.

Lieut.-Colonel Duncan MacPherson (1858- ?) and Richard C. Laurie were active for years on Canadian Pacific Railway surveys; Alexander Bell Ross was with the British Yukon Railway; George E. Perley served with the Intercolonial Railway. Lieut.-Colonel W. M. Davis (1857-1918), who began his professional career by participating in land surveys in northwestern Canada, was City Engineer at Prince Rupert from 1910 to 1913. Another member of the class was Major John Bray Cochrane who, after serving for many years as Professor of Surveying and Science at Royal Military College, became head of the Survey Division of the Canadian Army. During Cochrane's career on the college staff a number of cadets, who later became famous in the services or professions of Canada, learned military surveying and mapping from him.

From the ranks of subsequent classes of cadets, graduating prior to the turn of the century, came such eminent civil engineers as Col. (Sir) Percy Girouard (1867-1932), Col. H. J. Lamb, Brig.-General Francis D. Lafferty (1877-1919), Col. Reuben W. Leonard (1859-1930), and Major H. Grahame Starr (? -1925). All of these men, at one time or another, were active in surveying for the Canadian Pacific Railway.

The college also trained men who later achieved distinction in marine surveying. William James Stewart, the first Chief Hydrographic Surveyor of Canada, was succeeded in that position by a fellow-graduate, Frederick Anderson. Another graduate, Donald Colin Campbell, was associated for a time with the Georgian Bay Survey. Major Horace Heatherington Lawson was engaged on hydrographic surveys from the time of his graduation until 1914. From 1917 to 1942 he was Professor of Civil Engineering and Astronomy at Royal Military College.

James White, Chief Geographer, Department of the Interior, during the first decade of the 20th century, graduated from Royal Military College in 1883.

Lieut.-Colonel Ernest Wilson Hubbell (1862-1943), a graduate in 1887, became Chief Inspector of Surveys, Department of the Interior. Major-General W. B. Anderson of Class '97 early in his military career, as has been noted, was appointed first head of the Survey Division of the Canadian Army in 1906. Frederic Hatheway Peters, a graduate in 1904, was named Surveyor General of Canada (Dominion Lands) in 1924 and served in that office until 1948. Lieut.-Colonel LeRoy Fraser (Leary) Grant surveyed at Prince Rupert for the

Grand Trunk Pacific Railway from 1907 to 1909. From then until the outbreak of the First World War he performed land and irrigation surveys in the west coast province for the government of British Columbia.

The Royal Military College cadet who was awarded the Governor General's Gold Medal in 1910 when he graduated, became Sir Edward Oliver Wheeler (1890-1962). He was knighted in 1943 after he had been appointed Surveyor General of India. Lieut.-Colonel Frederick Fraser Hunter of Class '98 became Assistant Director of Surveys of Mesopotamia, following the First World War. In 1925 he was appointed Director of Surveys and Map Publication in the Survey of India and is reputed to have been the first such official to make use of aeroplanes for mapping the more rugged parts of that country.[13] Lieut.-Colonel Eedson Louis Millard Burns (1897-   ), Class of 1915, was appointed head of the then newly-formed Geographical Section, General Staff, in 1925. This placed him in charge of all military survey work in Canada.[14] This Section replaced the Survey Division, also officially known as the Topographical Survey Section. Burns developed air-photo survey methods widely used in the Second World War. He became an authority in photogrammetry and, as Lieut.-General Burns, served as Canada's delegate to international disarmament talks at Geneva. He was succeeded as head of the Geographical Section, General Staff, by Major J. E. Lyon who had also attended Royal Military College.

Canadian achievements in surveying and mapping generally are the more impressive because so many of them bear the indelible stamp of men who gained their early training at Royal Military College in Kingston.

15

EARLY ASTRONOMY IN CANADA: SURVEYING AND MAPPING THE HEAVENS

"A sun and moon, which kept their course, and lighted . . . the earth"
Anthony and Cleopatra, Act 5, Sc. 2

The first astronomical instruments to reach Canada, suitable for systematic use in observatories, arrived in Toronto in 1839. This equipment came from a dismantled British observatory on the island of St. Helena in the South Atlantic and was intended for Canadian use in what was, in its first years, essentially a magnetic observatory. Apparently up to the mid-1830s there were no observatories in the Western Hemisphere. This lack was a cause of deep concern to the British Admiralty which relied on such facilities for accurate determination of time and for the fixing of geographical positions. The Toronto observatory did not, however, acquire a telescope until 1881.

A former Dominion Astronomer, Dr. C. S. Beals, on examining an early photograph of the Toronto institution, found that the building did not include a dome in which substantial astronomical instruments could have been mounted. The structure did contain a small extension where a surveyor's theodolite was installed, presumably to help provide azimuths in connection with measurements of magnetic declination.

In 1850 Lieut. Ashe was appointed Astronomer at Quebec and construction of a tiny observatory was completed there in 1854. Citizens of Kingston were inspired by the occurrence of a solar eclipse, in that same year, to purchase a telescope and astronomical observations began in that Ontario community in 1857. But what is more or less officially described as the first astronomical observatory to be built in Canada was completed at a cost of £170 9s. 7d. in Fredericton, New Brunswick, in 1851. This wooden structure was surmounted by an eight-sided dome and pyramidal roof which together helped to make its appearance unique. The building had two wings, each 12 feet square. The telescope it housed cost several times more than the building.

The establishment of these pioneer facilities on the campus of King's College, later the University of New Brunswick, is mainly credited to the initiative and vision of two men, Sir Edmund Walker Head (1805-68) and the Scottish-born Dr. William Brydone Jack (1819-86), professor of mathematics, philosophy and astronomy at this New Brunswick college.

Dr. Jack, it should be noted, was as much at home in practical surveying work as in the observatory or in a lecture hall. Sir Edmund, who served as Lieutenant-Governor of New Brunswick from 1848 to 1854, was Governor-in-Chief of Canada, 1854 to 1861. He was instrumental in bringing about the introduction at the college of a course in engineering, reputed to be the first university course of its kind in Canada. Sir Edmund Head inaugurated as well the practice of responsible government in New Brunswick and was one of the first to advocate a practical plan for union of the provinces, thus foreshadowing the achievement of Confederation. It was his keen interest in the struggling institution and its possibilities that saved the college from extinction in the 1850s. Sir Edmund strongly recommended to the college council that lectures be provided not only in classical learning but in courses of a more practical nature as well. In December, 1853, King's College advertised a course in Civil Engineering to embrace " . . . methods of Surveying with the Theodolite, Circumferenter, etc . . . Method for determining best route for Railway . . . Railway curves and side widths; Calculation of gradients . . . ".*

Dr. Jack, a tall, strong, vigorous man, took a special interest in the observatory project from the start and equipped it with the best astronomical instruments available in that period. Undoubtedly general interest quickened in this undertaking following installation of a telescope in May, 1849. In collaboration with an observatory at Harvard University, Boston, operated by Professor Bond, accurate determinations of the longitude of Fredericton, Saint

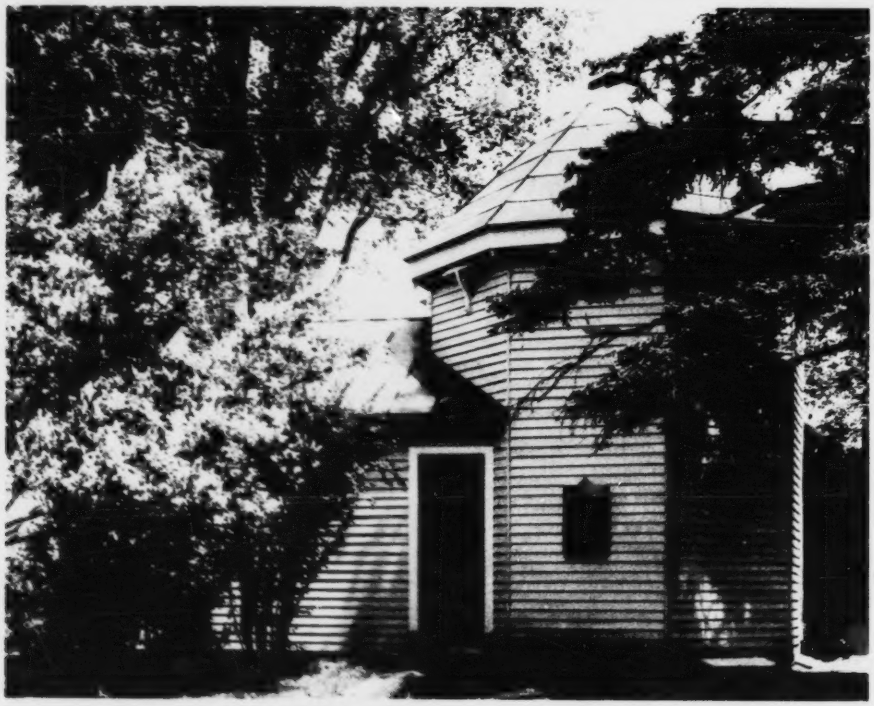

FIGURE 110. Brydone Jack Observatory on the campus of the University of New Brunswick.

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*J. E. Kennedy, R.A.S.C. Journal, V. 49, nos. 4 and 5, 1955.

John, Grand Falls and Edmunston were made. For these purposes use was made of the newly-invented electric telegraph. All this surveying activity occurred in the 1850s.

In 1859 King's College became the University of New Brunswick and in the university calendar for 1864-65 is found a description of this pioneer observatory and of its contents:

"In the Observatory there is a large Achromatic Telescope of 6 inches clear aperture and 7½ feet focal length, by the celebrated makers Merz & Son of Munich. It is equatorially mounted, and provided with clock-work motion, and a delicate and beautifully constructed Wire Micrometer for measuring the relative positions of double and multiple stars . . . It is sufficiently powerful to exhibit all the principal objects of interest in the heavens and for size and efficiency is unequalled by any Telescope in British North America. In the Transit-room of the Observatory there are two very superior sidereal Chronometers and a thirty-inch Transit Instrument by Troughton and Simm, of London. The other Astronomical and Geodetical Instruments by the same makers are, a fine Altitude and Azimuth Instrument, with four Micrometer Microscopes, a large Theodolite with two Telescopes; a Gravatt's Level with Levelling Staves, and an eight-inch Sextant with artificial horizons and Stand. The University is probably far better provided with Optical Instruments than any Institution of the kind in the British Provinces."

The transit of Venus in 1882 undoubtedly stimulated a considerable amount of interest in this country but the solid growth of astronomy in Canada owes its origin chiefly to problems associated with the surveying of large areas within our far-flung borders. A substantial debt of gratitude is owed also in this field of effort to trailblazers such as Sir Edmund Head and Dr. Jack. Their foresight and bold action, despite formidable obstructive and discouraging forces, made it possible for Canadians in later years to meet in praiseworthy fashion a great challenge.

Canada was fortunate, at the beginning of the 20th century, in having the services of four exceptionally gifted men who were deeply interested in the field of astronomy. William Frederick King, Otto Julius Klotz, Robert Meldrum Stewart and John Stanley Plaskett, were especially gifted and well-trained in physics and mathematics, and became scientists of outstanding character and merit. Their persistent efforts, combined with the drive and foresight of Hon. Clifford Sifton, Minister of the Interior, had, by the end of the First World War, brought about in this country remarkable progress in the tasks of surveying and mapping the heavens.

At the time of Confederation astronomers generally had only limited concepts of the dimensions and form of the universe. Less than thirty years previously man had made his first accurate measurement of the distance of a star, other than the sun, from the solar system. Nor at that time had any reliable method of determining the radial motions of stars been devised. Nevertheless significant forces were at work in the scientific world, developments promising to change the entire approach to astronomy. In the closing years of the 19th century the attention of astronomers was being diverted from the solar system to studies of the sidereal system, a trend spurred by the prospect of achieving measurements of the positions and apparent motions of the stars. As a result of advances made in the period between 1867 and 1916 concepts of the dimensions of the universe had been extended impressively into space.

One method of measuring distances to stars involved applications of stellar spectroscopy. This branch of science was only a few years old at the time of Confederation; its introduction marked the birth of astrophysics, including revelations of the physical and chemical composition of celestial bodies. Information on the brightness and magnitude of stars could be obtained by comparing intensities of lines in their spectra, colored bands or lines resulting from the dispersion of beams of light from these luminous bodies on passage through a prism.

The formation and early development of the Dominion Observatory and of the Geodetic Survey of Canada can be attributed, in the main, to the quiet-mannered, unassuming Dr. King. He was brought to Canada from England by his parents at the age of eight. After early schooling in Port Hope, Ontario, King graduated in arts from the University of Toronto in 1869 with high honors, including the gold medal in mathematics. In November, 1876, at the age of 22 he was commissioned a Dominion land surveyor and Dominion topographical surveyor. After serving as Inspector, then Chief Inspector of Surveys in the Department of the Interior, King was appointed Chief Astronomer of Canada in June, 1890. His wife, Augusta Florence Snow, was the daughter of the Dominion land surveyor, John A. Snow.

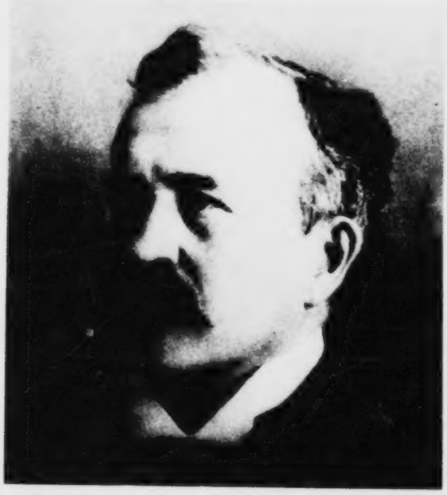

FIGURE 111
Dr. W. F. King.

Previous to 1885 very little astronomical work had been performed in Canada. But with the creation of the Railway Belt in British Columbia detailed azimuth surveys of that region were urgently required. It was necessary to tie in this work occasionally with points whose latitudes and longitudes had been determined already by astronomical methods. O. J. Klotz and Thomas Drummond were entrusted with this undertaking in 1885, an assignment described in a previous chapter of this volume. Three stations were occupied in that season, with Seattle serving as a preliminary base point. It was during these surveys that Klotz became the first Canadian scientist and civil servant to whom the term 'astronomer' was applied by a government department.[1]

Entries in the unique diary kept by Klotz, with particular reference to the closing years of the 19th century, shed light on working conditions of those times:[2]

"*July 15, 1896*—King finishes observations with Montreal in regard to the longitude of Ottawa on which work he has been engaged for the past two months."

"*September 3, 1896*—Message from W. F. King concluding with the words 'estimates O.K.'. This means my name is included in the estimates for being put into the Inside Service as 'Astronomer'. [This development indicated that Klotz, in effect, had been promoted from temporary to permanent status in the federal civil service.] . . . The usefulness and pleasure of the bicycle has taken such a firm root in the public that it is quite common now among the farmers, young women and young men."

Over the years the social and working relationships between King and Klotz were cordial and cool by turns. The diary significantly reflects these frequent variations in human temperature:

"*September 23, 1896*—King . . . is my best companion in Ottawa, for with no other can I speak so interestingly on subjects congenial to both of us."

"*August 7, 1897*—This morning King told me it had been settled that Brabazon was to go to B.C. to examine the boundary line (49th parallel). I asked him why I wasn't being sent, the work being principally astronomical . . . I saw Deville and told him the state of affairs. He told me of some trouble he had with King . . . Saw Sifton who remarked, "What has King to do with this appointment, if Brabazon is not an astronomer . . . ?"

The rivalry between the two men was always keen. Klotz was particularly sensitive to slights, real or imagined, in regard to their relative abilities as scientists. He was puzzled over what he considered to be the unfriendly attitude toward himself of Deputy Minister Burgess. "The only plausible reason seems to be to lower me in order to give King more prominence. He knows, as King does too, that I am King's superior in many things although King is my superior as a pure mathematician."[3]

The diary record contains an entry of significance in the story of Canadian mapping:

"*August 31, 1897*—Busy getting out a map of Southeastern Alaska, a map prepared under my direction and partly my own work. It's a compilation of 1893-4-5. The map was finished a year and a half ago but with . . . procrastination and inactivity [of others] . . . it was not photographically reduced to fit our largest lithographic stone . . . ".

Early in 1897 Deville recommended to the Deputy Minister of the Interior that an astronomical observatory be established in Ottawa "in connection with the longitude work in the West". This proposal was approved by the government for construction on Cliff Street, just north of the present site of the Supreme Court of Canada building. In the following year a 3-inch astronomical transit and a sidereal clock were purchased. By means of the latter instrument accurate time was obtained from observations of meridian passages of the stars, rather than from the sun. In addition an 8½-inch reflecting telescope with equatorial mounting was installed. By this type of mounting the axis about which the telescope operated was fixed approximately parallel to the axis of the earth. King's appointment as Chief Astronomer came two years after this development and constituted the first official recognition in this country of astronomy as a separate division of federal government activity. Klotz, shortly afterward, was named Assistant Chief Astronomer.[4] For the next several years some further longitude work was performed and additional instruments secured but prospects for a permanent observatory building remained dim.

In 1892 the federal government, partly as a result of representations from the Royal Society of Canada, cooperated with the British government in the determination of the longitude of Montreal in relation to Greenwich. This task was supervised by the Astronomer Royal, with Klotz participating as Canadian observer. Shipping interests, particularly, were vitally concerned in the results of this work. Four years later the longitude of Vancouver, in relation to Montreal and Ottawa, was also established.

In the summer of 1902, when the laying of the trans-Pacific cable approached completion, King advised Minister of the Interior Sifton that the installation presented a timely opportunity for the extension of Canada's chain of longitudes from Vancouver to Australia and New Zealand. The Chief Astronomer pointed out that the value to shipping interests of accurate positions in the Pacific Ocean would be even greater than in the Atlantic and that the completion of the first longitude circuit of the globe would constitute a notable accomplishment for Canada. Sifton, in October of 1902, was successful in inducing the government at Ottawa to authorize the project. Klotz was placed in charge, with F. A. McDiarmid and Frederick William Orion Werry as his assistants. In these longitude determinations full use was made of the time-checking facilities available through the cable. By January, 1904, the task had been completed.

Despite numerous set-backs at Ottawa the three musketeers, King, Klotz and Deville, continued to press for the construction of an adequate building for observatory purposes and they found comfort and encouragement in Sifton's understanding and helpful attitude. Finally, in 1900, the government placed the sum of $16,000 in the estimates of that year, specifically to provide for the erection of a suitable structure and for the purchase and installation of new instruments. A tentative site near the West Block on Parliament Hill failed to receive approval and the ultimate choice was the present location in the Central Experimental Farm. One of the principal factors entering into the decision to build the observatory was the ability of authorities in Ottawa at the time to foresee the need of numerous astronomical stations across Canada for the correlation of surveys generally and for mapping purposes, including advantages derived from regular programs of observations to determine star positions. In 1901 a 15-inch equatorial telescope and a sidereal clock were ordered for the new Dominion Observatory.

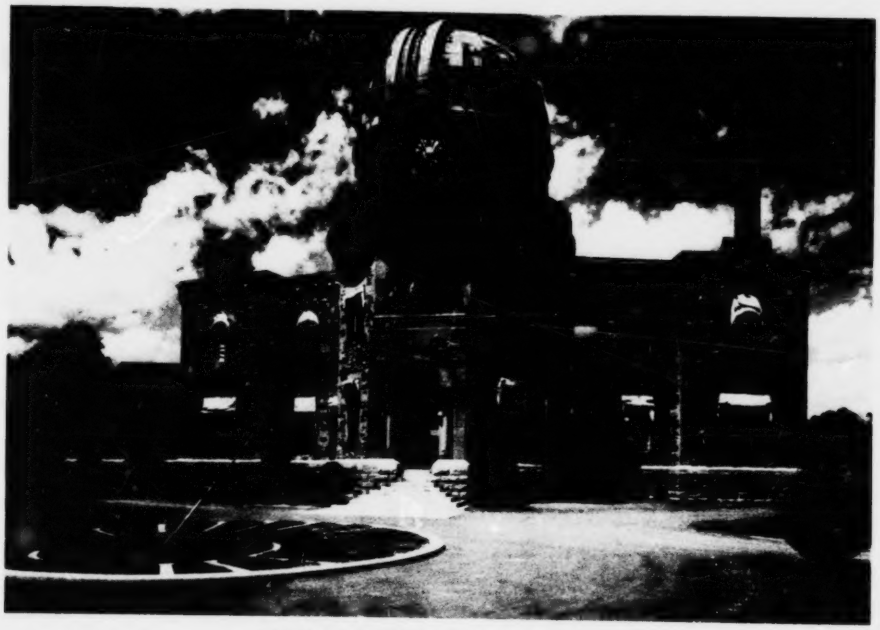

FIGURE 112. Dominion Observatory, Ottawa.

In the following year King sought the services of a man competent to advise on types of other instruments required and methods of installation.[5] Professor W. J. Loudon of the University of Toronto, a close personal friend of King, recommended the employment in that capacity of John Stanley Plaskett (1856-1941). The latter joined the Observatory staff in the summer of 1903. This action marked the beginning of a distinguished career in the public service that spanned the first four decades of the 20th century, a period during which Plaskett took a leading part in astrophysical research, as well as writing prolifically in this field. A son, H. H. Plaskett, later entered the same organization in Victoria, emulating his

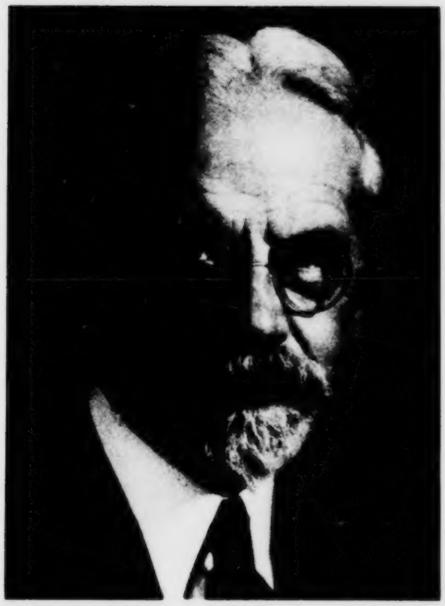

FIGURE 113
R. Meldrum Stewart.

father in persistence of research and in writing on various technical aspects of astronomy. In recognition of his outstanding contributions to knowledge in this realm of science H. H. Plaskett was appointed Director of the University Observatory in Oxford, England, serving in that post for the remainder of his active career.

Also in 1903 another brilliant graduate of the University of Toronto in physics and mathematics joined King's tiny staff. Robert Meldrum Stewart (1878-1954) was born in Gladstone, Manitoba, the son of a Presbyterian minister. When he graduated in 1902 young Stewart was awarded the University Gold Medal. Longitude determinations formed the major part of Observatory activities at the time Stewart arrived in Ottawa. He took a continuous, close and active interest in the expansion of this phase of the work until, years later, it became the responsibility of the Geodetic Survey of Canada. The first longitude determination involving the use of wireless time signals was performed under his direction in 1914. Another major development in Canadian astronomy, almost entirely due to Stewart's efforts, was the installation of a meridian circle telescope and the inauguration of accurate determination of fundamental star positions. He showed remarkable ingenuity and resourcefulness in detecting and eliminating numerous sources of instrumental errors peculiar to operations of this nature. Dominion Observatory catalogues of some 10,000 accurate stellar positions remain today as a monument to Stewart's ability and unflagging industry.

In April, 1905, the Dominion Observatory building was occupied by the astronomical and boundary-survey staffs. Chief Astronomer King at this time received the additional title of Director of the Dominion Observatory. The total number of civil servants housed in the new structure was 31. Because of the close interrelationship of astronomical and boundary surveys it never was possible to draw a clear-cut line of division between their respective responsibilities, although 14 men of the total were definitely engaged in field work on the international boundary. Among pioneer personnel of the Observatory Division, R. Meldrum Stewart was listed as observer and superintendent of time service. F. A. McDiarmid was classified as an observer, as were the Dominion land surveyors, W. M. Tobey, D.T.S. and F. W. O. Werry.

Functions of the new division were allotted among four units—Surveys; Meridian Work and Time Service; Geophysics; and Astrophysics and Solar Research. Within the space of a few years the last named was subdivided into three sections—Solar Physics; the Fifteen-inch Equatorial; and Photographic Photometry. Klotz, placed in charge of the Geophysics unit, organized his domain into three sections dealing with Seismology, Terrestrial Magnetism, and Gravity. He was intensely interested in seismology and for the next 12 years gave a great deal of attention to this aspect of his responsibilities. During that period he built up a high international reputation for the seismological station in Ottawa.

As a lecturer Klotz was in lively demand. He quickly enlisted and easily held the interest of audiences whether these were composed of fellow scientists or of members of the general public. This opening passage from an illustrated address he delivered on February 22, 1912, is typical of his style of speaking in popular vein:

"We have learned of the physical constitution of the moon, of her volume and mass, of her phases and rotation, of her borrowed light, of her gravitational or tidal effect on the earth—and now what about her connection with our weather, what about change of the moon, change of weather? Let us calmly do a little bit of reasoning about this; let us use just a little bit of common sense, and see what conclusion we inevitably arrive at."[6]

An expedition to Labrador in 1905 was organized to observe the eclipse of the sun on August 30th of that year. This was the first important field project undertaken by the Dominion Observatory in solar physics. J. S. Plaskett was entrusted with the leadership of this enterprise. Although cloudy conditions on site prevented useful observations of the phenomenon, Plaskett's report on the planning involved and of the trip itself, stamped him as an astronomical scientist of special ability and promise.

In 1907 Plaskett arranged for the provision of a new spectrograph incorporating the most advanced mechanical and optical ideas of that time and which utilized to the full the relatively small light-gathering power of the Ottawa telescope. He specialized in spectroscopic studies of binary-star systems. As a result of his intensive and fruitful work in this field the Dominion Observatory came to occupy a place in the front rank of institutions throughout the world engaged in this branch of astrophysical research.

Studies of the two natural earth-forces of terrestrial magnetism and gravitation, interrelated through their common source in the electrical nature of all matter, were not neglected. In 1907 Klotz inaugurated a systematic magnetic survey of Canada. At every magnetic station occupied observations were made for declination, dip and total force. By 1930 there were more than a thousand occupied stations, representing more than 650 localities. Although a few gravity stations were occupied in early years of the Observatory's existence, the work in this field was relatively spasmodic, owing to a lack of trained observers. The main object of these operations was to study the figure of the earth and the nature of subterranean strata.[7]

In his annual report to King, dated 1911, Plaskett strongly recommended the erection of a large reflecting telescope in order to extend the work of the Observatory to fainter stars. His representations were based, in all likelihood, on a resolution passed at a meeting in Ottawa that year of the Astronomical and Astrophysical Society of America, in which approval of the work accomplished with the 15-inch refractor telescope was expressed and the hope ventured that the Canadian government would provide a larger instrument. Plaskett's plea received additional support from both the Royal Astronomical Society of Canada and the Royal Society of Canada in the form of similar resolutions passed during the following year. In the brief of the latter organization it was suggested that the telescope be located at

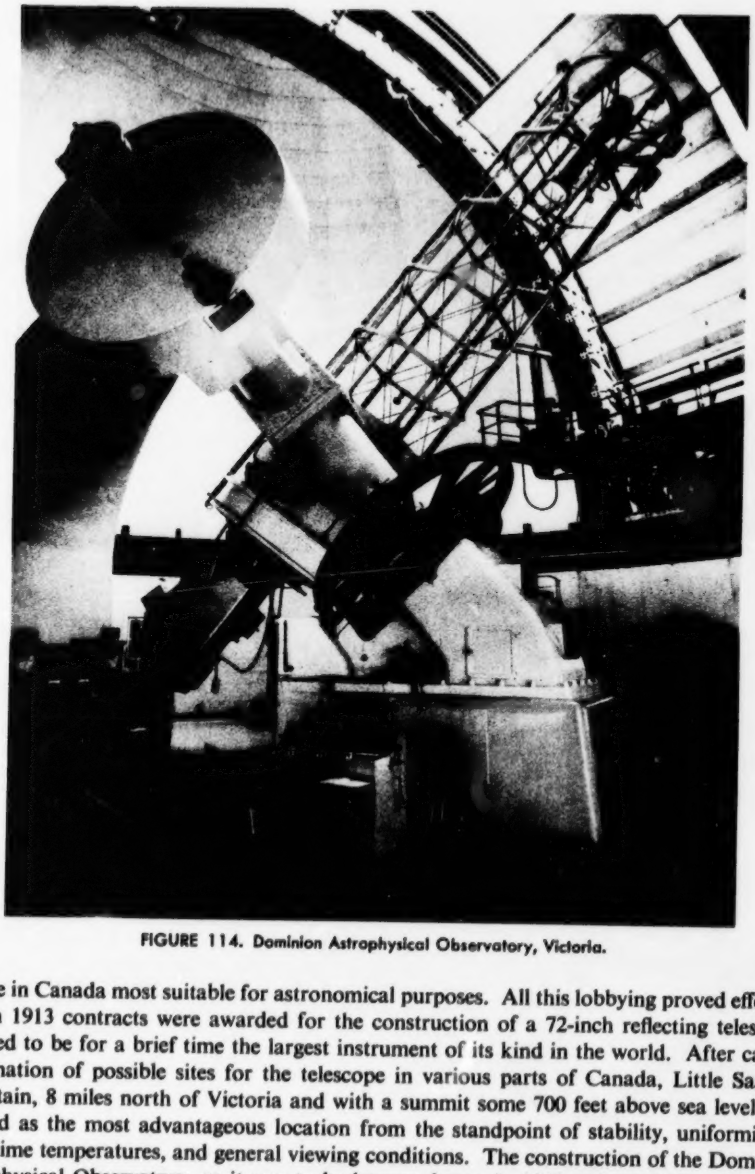

FIGURE 114. Dominion Astrophysical Observatory, Victoria.

a place in Canada most suitable for astronomical purposes. All this lobbying proved effective and in 1913 contracts were awarded for the construction of a 72-inch reflecting telescope, destined to be for a brief time the largest instrument of its kind in the world. After careful examination of possible sites for the telescope in various parts of Canada, Little Saanich Mountain, 8 miles north of Victoria and with a summit some 700 feet above sea level, was selected as the most advantageous location from the standpoint of stability, uniformity of night-time temperatures, and general viewing conditions. The construction of the Dominion Astrophysical Observatory, as it was to be known, began in 1915 and was fully completed three years later. J. S. Plaskett was named its first Director in April, 1917, and R. K. Young was appointed his assistant.[8] Later these two men were joined by W. E. Harper, H. H. Plaskett and, in 1924, by J. A. Pearce.

In theory the Director of the Dominion Observatory was in general charge of both the

Ottawa and Victoria establishments but in practice the Director of the latter institution was granted considerable freedom in the preparation and execution of research programs. By reason of the large size of the Victoria telescope it became possible to carry out investigations indispensable to the advancement of astronomical knowledge and this installation helped, during the years ahead, to bring prestige to Canada.

When the Geodetic Survey of Canada and the boundary surveys separated from the Observatory organization in 1917 a reorganization of the Observatory's functions took place. Scientific work of the Observatory was divided into seven main categories: Astronomy of Position (Meridian Work and Time Service); Solar Physics; the Fifteen-inch Equatorial; Photographic Photometry; Seismology; Terrestrial Magnetism; and Gravity.

FIGURE 115
J. S. Plaskett.

In their efforts to promote the work and objectives of the Dominion Observatory, King and his colleagues were frequently called upon to justify to policy-makers on Parliament Hill their researches in the realm of pure science. Governments, in the political nature of things, want to see practical results for the expenditure of public funds. It was incumbent upon the civil servants, time and again, to explain patiently that all practical applications of science are built upon findings derived from the testing of various theories. Stewart, for example, in defending requests in 1930 for increased government support of Observatory activities, dipped perceptively into the future:

" . . . astronomers are working hand in hand with physicists in investigations on the ultimate constitution of matter, each supplementing the work of the other. What will come out of such investigations we do not yet know, but if they should result in the harnessing of atomic and molecular forces for practical use, all the expenditures made on astronomy and physics during the course of history will be many times repaid".[9]

Following the death of Klotz late in 1923, after nearly 45 years in the public service of Canada, a touching tribute was paid to him and his work by the Board of Examiners for Dominion Land Surveyors of which he had been an "active and valuable member since

1883 and whose consummate scientific attainments reflected the greatest credit not only on this Board but on the country he so brilliantly and faithfully served and through whose efforts the profession of . . . surveyors has attained such a high degree of efficiency".[10] On this occasion the close friend, fellow-worker and admirer of Klotz, namely, Surveyor General Deville, by nature a most reserved and undemonstrative person, was visibly moved. King's life had come to a close seven years previously. Now Klotz had gone. Deville alone remained, the bereft survivor of this remarkable trio of scientific intellects. Deville appeared to be overwhelmed by a sense of loneliness and, possibly, by an awareness that for him, shadows were fast closing in.[11] Actually it was but a matter of months before Deville joined his eminent colleagues beyond that veil thus far unpierced by scientific insight or instrument.

During the half-century following Confederation, thanks to its resourceful, energetic and dedicated scientists, Canada had made commendable advances in the several fields of research represented in the organization of the observatories in Ottawa and Victoria. In 1927 Director Plaskett summed up that progress in memorable terms:

" . . . Canada's contribution to modern astromonical research is one of which every Canadian has good reason to be proud, as to the best of my knowledge it is unequalled relatively, so far as Government support is concerned, by any other country. Canada, with its small population and its relatively short span of national life, has established and supported two national observatories of the first rank, one of these having the second largest telescope in existence and both making important contributions to science."*[12]

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*For a period of several months in 1918 the 72-inch reflector telescope of the Dominion Observatory in Victoria, B.C. was the largest in the world but was superseded by the 100-inch instrument at Mount Wilson, California.

16

THE ONTARIO-MANITOBA BOUNDARY: STAGE ONE

"And from that full meridian of my glory . . ."
King Henry VIII, Act 3, Sc. 2

It is not widely realized in this country, nor in the neighboring republic that a geographical point close to the centre of the continental United States has had a significant bearing upon the determination of a key location on an interprovincial boundary in Canada. During the closing decades of the 19th century legal and other arguments resounded in the new Confederation over the exact course of the northern and western boundaries of Ontario and, in particular, of the Ontario-Manitoba boundary line. In debates over the interpretation of treaties, proclamations, orders in council and other documents related to these issues, the point of junction of the Mississippi and Ohio rivers drew frequent and prominent mention. It is altogether likely that the location of the existing Ontario-Manitoba boundary terminal point on Hudson Bay resulted from the extension northward, from the confluence of these two major American rivers, of the 89th meridian of west longitude.

The vague terminology of several 18th century documents served to sharpen rather than allay disputes over the nature and extent of Ontario's territory. Under the Treaty of Paris, 1793, "in order to re-establish peace on solid and durable foundations, and to remove forever all subject of dispute with regard to the limits of British and French territories on the continent of America" the southwestern limits of Canada were "fixed irrevocably by a line drawn along the middle of the River Mississippi from its source to the River Iberville [Ohio], and from thence by a line along the middle of this river . . . to the sea".

In the Quebec Act (Imp. 14 Geo. III, ch. 83), passed eleven years later, it was provided that the Province of Quebec included "all the territories, islands and countries in North America belonging to the crown of Great Britain, bounded on the south by a line from the Bay of Chaleurs along the high lands which divide the rivers that empty themselves into the River St. Lawrence from those which fall into the sea, to a point in 45 degrees north latitude . . . until the said western boundary strike the Ohio; . . . and along the bank of the said river westwards to the banks of the Mississippi, and *northward* to the southern boundary of the territory granted to the Merchant Adventurers of England trading to Hudson's Bay".

Under authority of the Constitutional Act, 1791, providing for the establishment of

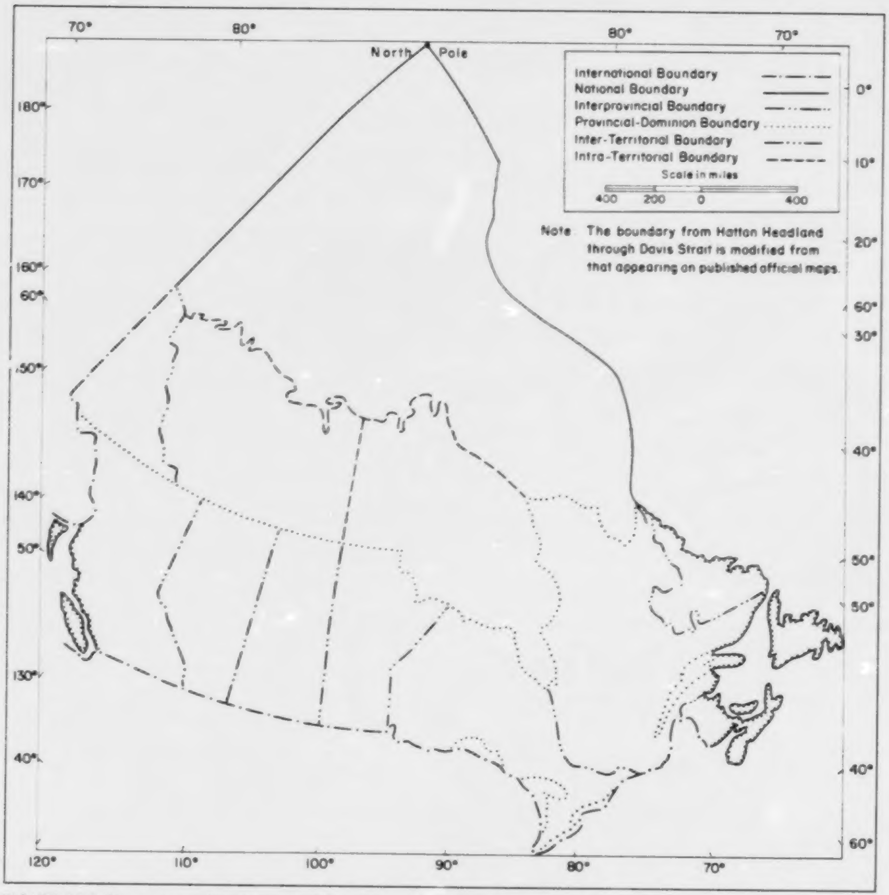
North Pole
International Boundary
National Boundary
Interprovincial Boundary
Provincial-Dominion Boundary
Inter-Territorial Boundary
Intra-Territorial Boundary
Scale in miles
400 200 0 400
Note: The boundary from Hatton Headland through Davis Strait is modified from that appearing on published official maps.
70°
80°
80°
70°
180°
170°
160°
60°
150°
140°
50°
130°
40°
0°
10°
20°
60°
30°
40°
50°
50°
40°
60°
120°
110°
100°
90°
80°
70°

FIGURE 116. The major political boundaries of Canada. The eastern part of the Arctic sector is only approximate.

Upper and Lower Canada, an order in council dated August 24, 1791* provided that the dividing line between the two provinces should "commence at a stone boundary on the north bank of the Lake St. Francis . . . to ascend the [Ottawa] River into the Lake Tomiscanning [Temiscaming] and from the head of the said Lake by a line drawn due north until it strikes the boundary line of Hudson's Bay; including all the territory to the westward and southward of the said line and the utmost extent of the country commonly known by the name of Canada". This rather expansive language led some zealous advocates of Ontario's territorial claims to place that province's western limits along the crest of the Rocky Mountains!

The more moderate position taken by proponents of Ontario's case as set forth in formal communications and proceedings was that by terms of the Treaty of Paris, 1763, under the Quebec and Constitutional Acts, and by subsequent official declarations, the western limits of the province extended to a meridian line passing through the source of the Mississippi River or, in the alternative, such limits should be fixed even farther west. On the other hand "northward" was interpreted by Ottawa authorities as meaning "due north" thus placing the boundary along the 89th meridian as projected due north from the confluence of the Mississippi and Ohio rivers.

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*Public Records Office, London, England.

In effect the disparity resulting from these differing interpretations was represented by the territory lying between a meridian passing close to Port Arthur (89° 09′) and a meridian passing just west of the Lake of the Woods (95° 14′). This area, some 275 miles in width, became known as "The Disputed Territory".

By the British North America Act (section 6) the former Province of Upper Canada was constituted the Province of Ontario and the western and northern boundaries of Upper Canada, as fixed by the Constitutional Act, 1791, became the boundaries of the new province. In 1870 the Parliament of Canada created Manitoba (33 Vic. ch. 3) and defined its boundaries as the international border on the south, parallel 50° 30′ north latitude on the north, the 96th and 99th meridians on the east and west respectively. A year later the power invested in Parliament at Ottawa to establish new provinces within Canadian territory and to increase, diminish or otherwise alter the limits of any province, with the latter's consent, was confirmed by statute (Imp. 34-35 Vic. ch. 28).

In the beginning Manitoba, lacking an ample provincial treasury and with its natural resources under Ottawa's control, was inclined to let federal authorities carry the battle to Ontario on its behalf in boundary disputes. The conflict came into the open, as a matter for inter-governmental negotiations, in July, 1871, when the Secretary of State for the Provinces, Hon. Joseph Howe, received in Ottawa a despatch from the Lieutenant Governor of Ontario. The message in part declared that "necessity exists for the settlement of the true boundary or division line separating the Province of Ontario from what is known as the North-West Territory. The importance of accomplishing this object has been recognized both by the House of Commons and the Legislature of the Province and appropriations [have been] made by them for defraying the expense of a Commission for that purpose, one member of which to be appointed by His Excellency the Governor-General and the other by myself. As the season is fast advancing it is desirable that these appointments be made at as early a date as possible . . . ".

Howe replied later in the same month, reporting that Parliament had voted $15,000 "to pay one-half the cost of surveying the said boundary line" and that Eugène Taché of Quebec City had been appointed Commissioner on the federal side. On September 19, 1871, Hon. William McDougall, a man seemingly attracted to controversy as by a magnet, was appointed Commissioner for Ontario. Nothing of substance, however, seems to have developed out of these initial moves and it was not until seven years later that fresh steps were taken by authorities to settle this boundary issue. Both the federal and Ontario governments agreed to the nomination of three arbitrators, namely, Chief Justice Harrison of Ontario, Sir Francis Hincks and Sir Edward Thornton. Their recommendations, known as "The Award" were announced in August, 1878. As matters turned out a House of Commons committee rejected "The Award" and consequently federal legislation to make it binding was not forthcoming.

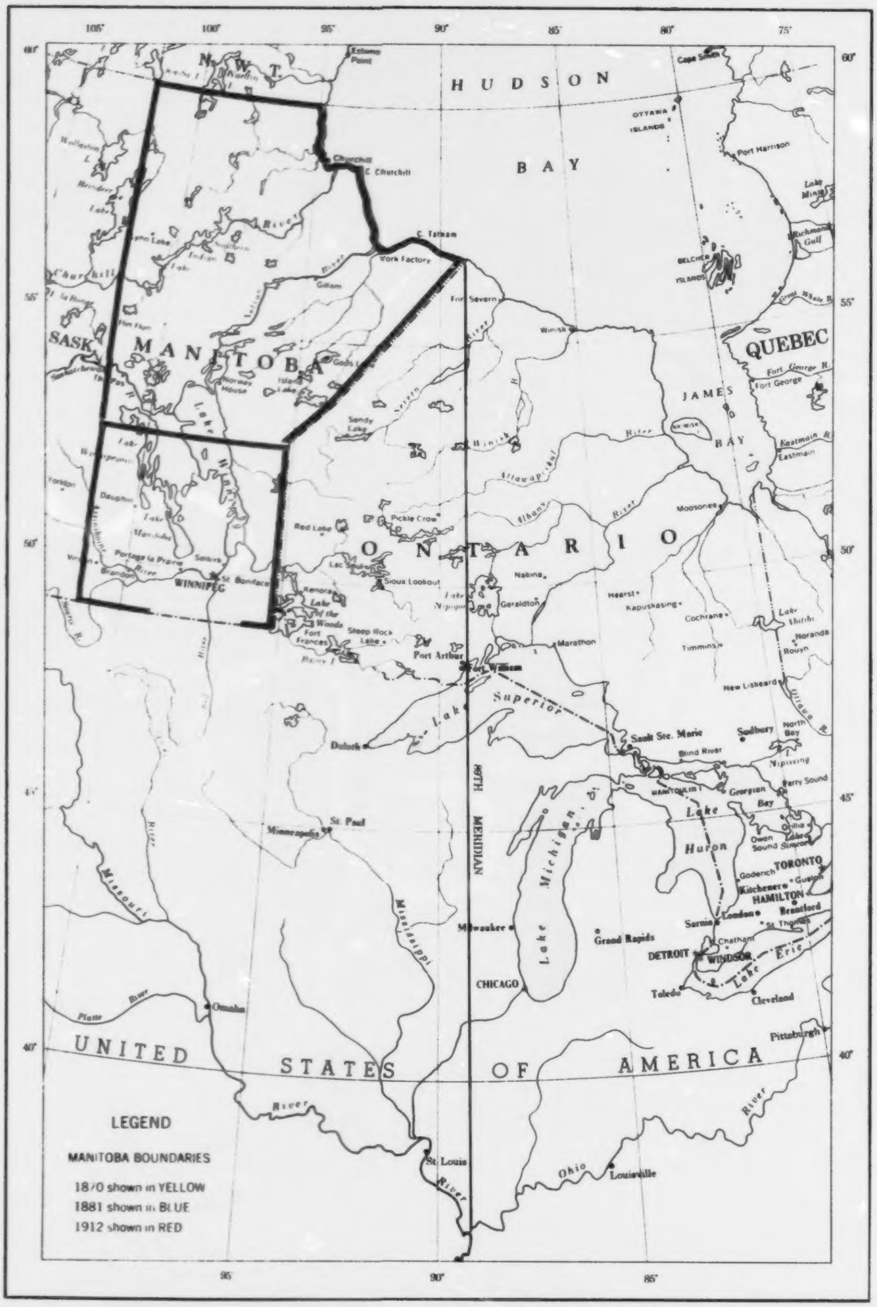
The decision of the three arbitrators nevertheless proved highly significant as their conclusions, in large measure, were approved and adopted in the judgment rendered in 1884 by the Judicial Committee of the Privy Council in London, England. For the purposes of this chapter the relevant part of "The Award" of 1878 decided that the boundary line should go " . . . westerly through the middle of Lac Seul, being the headwaters of the English River; thence westerly through the middle of Lac Seul and the said English River to a point where the same will be intersected by a true meridional line drawn northerly from the international monument placed to mark the most northwesterly angle of the Lake of the Woods . . . and thence south following the said meridional line to the . . . international monument".

It is likely that the House of Commons committee, in urging rejection of "The Award", was guided by testimony offered before it by Deputy Minister of the Interior, John S. Dennis, and by Surveyor General Lindsay Russell. Both men supported the view predominant in Ottawa's administrative circles, namely, that Ontario's western boundary lay along the prolongation of a meridian line drawn due north from the confluence of the Mississippi and Ohio rivers. The evidence given by Dennis consisted of his reading to the committee of a letter he had written to the Minister of Justice, Ottawa, on October 1, 1871, on the subject of the boundary between Ontario and the North-West Territories of that day. In his letter Dennis gave cogent reasons for his viewpoint and made some perceptive references to mapping in relation to the delineation of boundaries between nations:

"The map used in the House of Commons [Westminster] to illustrate the question of the boundaries of Quebec in the debate on the [Constitutional] Act is said to have been Mitchell's Map . . . The only copy of Mitchell's Map available is in the Library here [Ottawa] and on inspecting the Mississippi on it we find that the course of that river is taken up abruptly at a point in 47° 12′ north latitude and 101° 30′ west longitude at which point we further find in the map the following note by the author: 'The head of the Mississippi is not known. It is supposed to arise about the 50th degree of latitude and the west bounds of this map etc. . . . !" Dennis commented that it was "not at all probable that with the uncertainty asserted to exist in the map itself used by the House of Commons at the time the boundaries were debated and settled . . . that the House intended to use its [the Mississippi] banks as the [western] boundary of Quebec. Such a theory . . . would be entirely inconsistent with the minuteness and precision of language insisted on in settling the Ohio and the southern boundary . . .". Dennis further pointed out that the meridian line north of the junction of the Mississippi and Ohio rivers would intersect the height of land in Ontario just slightly northwest of Lake Nipigon. He concluded his report by advocating that Ottawa and Ontario authorities agree to fix a conventional or mutually convenient boundary, thus reducing by half the estimated cost of such boundary surveys.

In 1881 Parliament in Ottawa decided to extend Manitoba's boundaries (44 Vic. ch. 14) and thus enlarge its territory. The new northern boundary of the province was defined as the centre of the road allowance along the 12th Base Line of the Dominion Lands Survey System. Manitoba's eastern boundary was declared to be the western boundary of Ontario. Apparently Ottawa authorities held the view that there had not been, up to this time, a boundary line common to the two provinces but that there had been a strip of unallotted territory separating them. This legislative step drew angry protests from the Ontario government. In 1882 Attorney-General Oliver Mowat of Ontario asserted that it was a 'grievous wrong' that 39,000 square miles of territory rightfully belonging to Ontario should have been transferred to Manitoba.[1]

The conflict between these rival claims reached its climax during the summer of 1883 when three separate police forces and three distinct sets of magistrates, appointed by each of the three governments involved in the boundary controversy, took turns harassing, and even arresting, each other. The settlement of about 1,000 persons, now known as Kenora, was the vortex of the jurisdictional storm. When lumbermen invaded the area, competition for the monopoly in providing liquor and timber-cutting licences in the area stirred animosities to fever pitch. Both Ontario and Manitoba authorities exercised licence-granting functions and into this legal maelstrom bootleggers poured gleefully.[2] Ontario's magistrates refused to recognize liquor licences issued to saloons other than those granted by Ontario officials. A


HUDSON BAY
N.W.T.
MANITOBA
SASK
ONTARIO
QUEBEC
JAMES BAY
UNITED STATES OF AMERICA
89TH MERIDIAN
Churchill
C Churchill
C Tatnam
York Factory
Fort Severn
Gillam
Flin Flon
The Pas
Norway House
Island Lake
Gods Lake
Sandy Lake
Dauphin
Lake Manitoba
Lake Winnipeg
Portage la Prairie
Brandon
Selkirk
WINNIPEG
St. Boniface
Red Lake
Pickle Crow
Lac Seul
Sioux Lookout
Kenora
Lake of the Woods
Fort Frances
Steep Rock Lake
Rainy L.
Port Arthur
Fort William
Lake Nipigon
Geraldton
Nakina
Marathon
Hearst
Kapuskasing
Cochrane
Timmins
Moosonee
Noranda
Rouyn
New Liskeard
Sault Ste. Marie
Blind River
Sudbury
North Bay
Nipissing
Parry Sound
Georgian Bay
Owen Sound
Lake Simcoe
Lake Huron
Lake Superior
Lake Michigan
Lake Erie
Goderich
TORONTO
Kitchener
Guelph
HAMILTON
Brantford
London
St Thomas
Sarnia
Chatham
DETROIT
WINDSOR
Toledo
Cleveland
Pittsburgh
Grand Rapids
Milwaukee
CHICAGO
Duluth
St. Paul
Minneapolis
Omaha
St Louis
Louisville
Missouri
Mississippi
Ohio River
Platte River
Winisk
Attawapiskat
Albany River
Fort George
Eastmain
Port Harrison
Richmond Gulf
Cape Smith
OTTAWA ISLANDS
BELCHER ISLANDS
Eskimo Point
105°
100°
95°
90°
85°
80°
75°
60°
55°
50°
45°
40°
LEGEND
MANITOBA BOUNDARIES
1870 shown in YELLOW
1881 shown in BLUE
1912 shown in RED

MAP 15. Evolution of Manitoba's boundaries and the projection of the 89th meridian from the confluence of the Mississippi and Ohio rivers to Hudson Bay.

Manitoba-operated jail in Kenora was raided by an unruly mob and burned to the ground. Mowat in Toronto continued to complain that illicit liquor-selling, drunkenness, immorality and crime had increased because of the policing paralysis resulting from the federal government's attitude and policy in the boundary matter.

Disorder in the area under dispute reached such proportions that finally the attorneys general of both provinces met and worked out a compromise agreement. Local police commissioners, one for each province, were appointed. Both provinces agreed to submit a joint case on the boundary question to the Judicial Committee of the Privy Council for decision. In 1884 this case was argued in London and a decision rendered in favor of Ontario. In the main the lord justices confirmed the validity of "The Award" of 1878. In 1889 the northern and western boundaries of Ontario, as described in that award, were defined by statute (52-53 Vic. ch. 28).

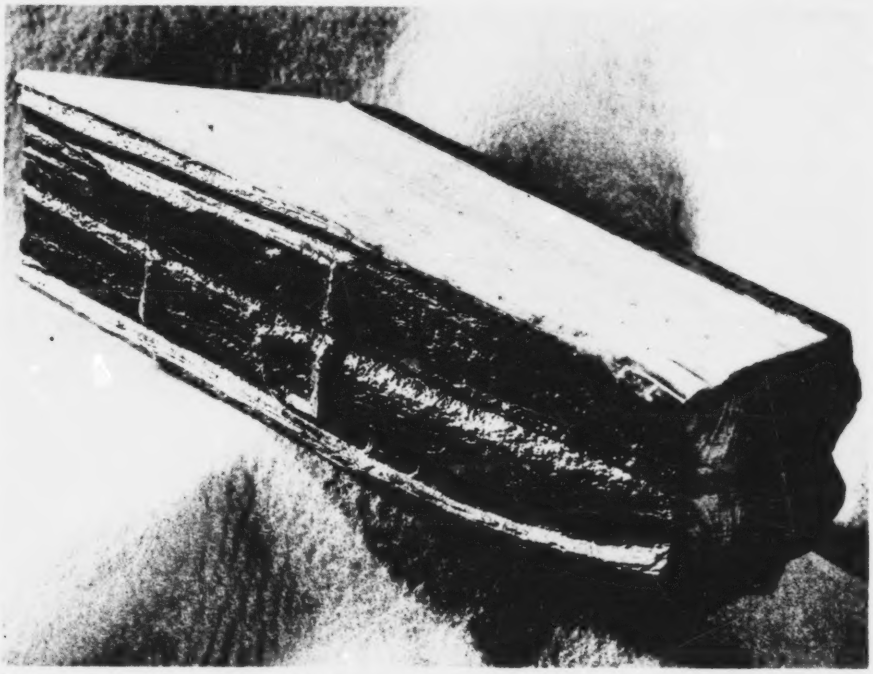


FIGURE 117. Section removed in 1932 from a poplar tree on the Ontario-Manitoba boundary to verify marks placed on it in 1897. Shown are the reverse of the original marks "BT".

Four years after legal confirmation by Parliament of the Privy Council decision the federal government invited Ontario and Manitoba to cooperate with the Dominion on a joint survey of the Ontario-Manitoba boundary line from the northwest point of the Lake of the Woods to the Winnipeg River.[3] A few months later the two provinces were advised by Ottawa that the cost of the proposed survey would not exceed $9,000 and the suggestion was made that it be shared equally by the three governments.[4] Manitoba, however, declined to participate in the proposed arrangement. Ottawa was advised that as Manitoba was "not the owner of the timber, the minerals or the public lands in that portion of the province lying along the eastern boundary thereof, it does not appear that the Provincial Government is sufficiently interested in the immediate limitation of the boundary to warrant the incurring of any expenditure at the present time".[5]

Not until 1897 were surveyors formally appointed and authorized as commissioners to run the boundary line, even to a limited extent. Hon. Clifford Sifton had been in office as Minister of the Interior for only a few months when, despite Manitoba's attitude of indifference, he instructed that correspondence on the boundary survey project be re-opened. As a result the Dominion and Ontario land surveyors Elihu Stewart and Bryce J. Saunders were selected by Canada and Ontario respectively for the discharge of this important task. The season was already well advanced but both surveyors were in the field by September 1, 1897.

Survey work began at the reference monuments established at the northwest corner of the Lake of the Woods by the International Boundary Commissioners in 1872. In the course of the next three and a half months the task of surveying the line was carried due north to its intersection with the Winnipeg River, about seven miles below the junction of the English and Winnipeg rivers and 58 miles, 27 chains and 20 links from the point of commencement of the survey. The waters of the two rivers at the confluence united in a wide, lake-like expanse containing about a dozen islands. A sky line was opened along the entire course of this line. An opportunity was thus afforded to take long sights from the most elevated points and so maintain direction. Astronomical observations revealed that pickets deviated but slightly from the true course. The line was carefully posted throughout with cedar and iron posts surrounded in most cases with stone mounds. A reconnaissance survey was made of the territory adjacent to the boundary and sustained, intensive effort was involved in traversing the shores of the lakes near the line.

A small, light transit as well as a Dominion Lands reiteration transit theodolite were the instruments mainly used in running the line. Astronomical observations were taken by means of the latter equipment. Lines run in the surveying of Indian Reserves, Dominion lands and mining locations were connected with the boundary work. Intensely cold and generally cloudy weather persisted from the latter part of November to December 11, 1897, when the survey project was completed in the field.

On April 30, 1898, Stewart and Saunders submitted their joint report to Hon. Clifford Sifton in Ottawa and to Hon. J. M. Gibson in Toronto, along with official plans of survey signed by both surveyors. Nearly a quarter-century elapsed before surveying of this interprovincial boundary line was resumed in a second stage of this work. Officially the government of Canada, in 1898, invited Ontario and Manitoba to accept the boundary as marked by Stewart and Saunders in Stage One. Ontario accepted in statutory form (62 Vic. ch. 2) but Manitoba remained silent.

In 1912, by two acts of Parliament and with the legislative consent of the two provinces concerned, vast areas were added to Ontario and Manitoba.[6] Inhabitants of the latter province had increased in numbers from about 62,000 in 1881 to an estimated 360,000 by 1906. This total exceeded the population of either Alberta or Saskatchewan, each of which had been allotted about 175,000 square miles more than Manitoba then possessed. It was felt at Ottawa, therefore, that Manitoba was entitled to a larger territory to enable it to occupy a place among the provinces more in accordance with the spirit that had animated the act of Confederation.[7] The interprovincial boundary was thus carried due north along the same meridian marked by Stewart and Saunders to its intersection with the centre of the road allowance of the 12th Base Line of the Dominion Lands Survey System, thence northeasterly in a right or straight line to the most easterly point of Island Lake, thence northeasterly to the point where the 89th meridian intersects the southern shore of Hudson Bay. Just why the 89th meridian should have been selected as the governing line in this particular connection is open to speculation but there is the matter of its historic relationship, under terms of the Quebec

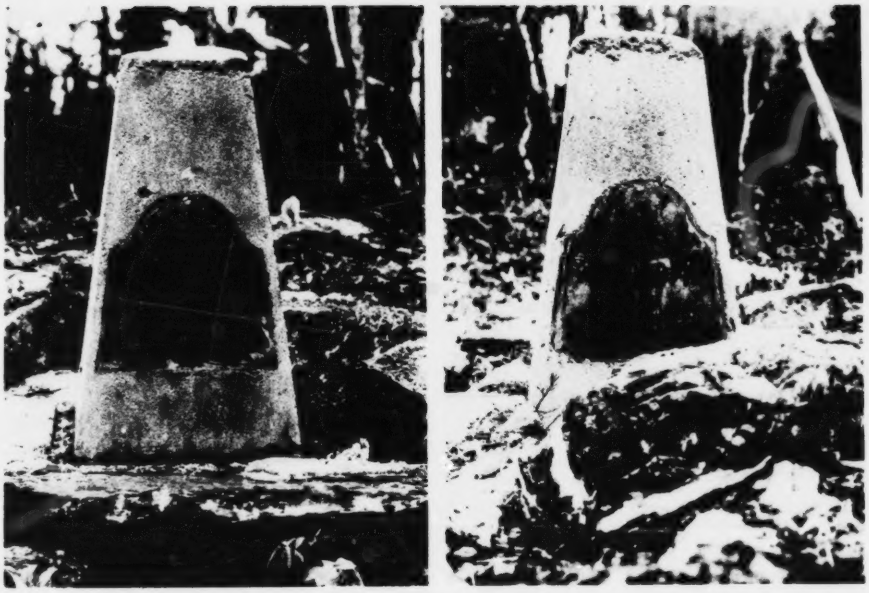


FIGURE 118. Views of typical Ontario-Manitoba boundary markers erected in 1922.

Act, with the confluence of the Mississippi and Ohio rivers. Nor should it be overlooked that by extending Manitoba's boundaries in 1912 in this way, the total acreage of the province was increased to the point where it more nearly coincided with the amount of territory allotted seven years earlier to each of the newly-created provinces of Alberta and Saskatchewan.[8] In retrospect it is significant to recall that the point at which the 89th meridian strikes Hudson Bay is the only part of the proposed Dennis-Russell line that was finally adopted as the interprovincial boundary.

The necessity of marking on the ground the extension of the boundary of the two provinces became the subject of correspondence between the governments of Canada, Ontario and Manitoba during 1913 and 1914. The two provincial governments made a formal request to Ottawa that the extended boundary line be surveyed by the Department of the Interior at the expense of the federal government. This proposal was not accepted, however, and the matter of continuing the boundary surveys was dropped for a time. In 1920 Herbert Graham Beresford, a Dominion land surveyor, who had been surveying mineral claims for several years in the Rice Lake district of Manitoba, reported that claims were being staked so near to the supposed location of the interprovincial boundary that early official demarcation of the boundary north from the Winnipeg area through the newly-opening mining area was urgently required. Beresford's warning initiated a series of boundary surveys covering five more main stages of the entire project. In the field seasons of 1921 and 1922 surveying of the boundary was completed from the Winnipeg River north to the 12th Base Line. In 1929 and 1930 the seasons' work was continued from that point to Island Lake. The next stage was finished in 1937, namely, from Island Lake to Echoing River. In the 1937 and 1948 field seasons the last gap, that extending from Echoing River to the shore of Hudson Bay, was covered. In 1950 the final stage was completed, involving the monumenting of the line from Island Lake to Hudson Bay.

In all, the 20th century boundary surveying activities covered almost 550 miles of this line. These undertakings demanded the dedicated, reliable, energetic and resourceful services of such surveyors in the field as John Wesley Pierce, Robert Douglas Davidson, Cecil Herman 'Marsh' Ney, John Carroll, Edward Gauer, Edwin Frederick Gorman, J. G. Pierce and D. E. Guard. These men functioned under the direction of such eminent surveyor-commissioners as Edouard Deville, Louis Valentine Rorke, Bruce Wallace Waugh, Frederic Hatheway Peters, G. A. Warrington, Henry Edward Beresford and Frank Weldon Beatty. Along with the last two officials, Robert Thistlethwaite prepared a report on the boundary surveys from 1929 to 1950 and instigated steps leading to legislative action, confirming the laid-down line, by all three jurisdictions involved. An atlas of 39 maps accompanied the report. But the story of the second and subsequent stages in the boundary-marking work is told in a later chapter. Suffice to state here that extending across a period of 53 years the 607½-mile-long Ontario-Manitoba boundary line was effectively and efficiently surveyed so that, in the end, the results were accepted without reservation by the governments directly concerned.

17

EARLY SURVEYS OF INDIAN RESERVES

At the time of the first European settlements in North America the Indian population of what is now Canada was about 200,000. Shortly after the advent of people from the Old World the Indian population on this continent began to decline and continued to diminish for almost four centuries. In recent years, with a marked improvement in their living conditions and in health services, the number of Indians in this country has risen steadily and now exceeds 215,000. These descendants of the original inhabitants of the northern half of North America are organized in about 600 Indian communities or bands within a number of Indian agencies, and reside on more than 2,200 reserves, lands set aside over the years by government authorities for the use of Indians. These reserves are located across Canada, except in Newfoundland. They vary in size from a fraction of an acre to more than 500 square miles. Almost without exception Indian reserves in Canada have been surveyed in respect to outline boundaries or subdivision lines or both.

Under the French regime in Canada there never was an admission on the part of authorities that Indians had any valid title to lands. Territories in the New World were claimed for the French Crown by right of discovery and conquest. Reserves, however, were set apart from time to time for the use of Indians and these arrangements found formal confirmation in Article 40 of the Articles of Capitulation signed in Montreal in September, 1760: "The . . . Indian allies of his most Christian Majesty shall be maintained in the Lands they inhabit; if they chuse [sic] to remain there; they shall not be molested on any pretence whatsoever, for having carried arms . . . ".[1]

In contrast to the French attitude, in earliest British settlements in New England the title of Indians to lands occupied by them had been recognized. Compensation was made for any surrender to newcomers of their natural hunting grounds. This compensation might take the form of land grants, of payments in money or goods, or by combinations of these various types of reimbursement. The Crown invariably reserved to itself the exclusive right to deal with Indians for the surrender of their lands and this basic approach to such transactions, confirmed by Royal Proclamation, October 7, 1763, has been followed ever since. That proclamation, issued by George III, declared in part, "And whereas it is just and reasonable and essential to our Interests, and the Security of our Colonies, that the several Nations or Tribes of Indians . . . who live under our Protection, should not be molested or disturbed in the Possession of such Parts of our dominions and territories, as not having been ceded to Us, are reserved to them as their Hunting Grounds, We do therefore . . . declare . . . that no Governor . . . in any of our Colonies . . . do assume . . . to grant . . . Warrants of Survey . . . beyond the Bounds of their Respective Governments as described in their Commissions . . . upon and Lands whatsoever which, not having been ceded to or purchased by Us as aforesaid, are reserved to the said Indians, or any of them."[2]

In 1755 Sir William Johnson was appointed Indian Superintendent in the Mohawk Valley, now in New York State. The creation of this office marked the genesis of organizations in North America that administered and advanced, on behalf of governments, the best interests of Indian peoples. After the American Revolution the office of Indian Superintendent was moved to Canada. Sir Guy Johnson succeeded his father-in-law in the post in 1774, and remained in charge until 1782 when Sir John Johnson, a son of Sir William, was appointed Superintendent General and Inspector. He held this commission until that office was abolished in 1828, bringing to a close the 73-year-long reign of the Johnsons in this field of administration.

By the middle of the 19th century the Legislature of the Province of Canada had passed two statutes concerning reserves, one of which enacted that "tracts not exceeding 230,000 acres may . . . be described, surveyed and set . . . apart . . . for the use of the several Indian tribes of Lower Canada".[3] The other statute established the position of Commissioner of Indian Lands for Lower Canada, an official who represented the Crown for the purpose of managing reserve properties for Indians.

Over a period of years the whole of Upper Canada was surrendered to the Crown by treaties made by governments with Indians. In addition to the location of reserves within those surrendered territories, as compensation to Canadian Indians, land had to be found also for Six Nations Indians who had arrived in Canada after the American Revolution and who, by their loyal action, gave up their historic lands in the Mohawk Valley. Reserves for them were carved out of lands along the Grand River in what is now southwestern Ontario, and on the Bay of Quinte, Lake Ontario.

By 1830 there were separate departments dealing with Indian matters in both Upper and Lower Canada. Fourteen years later the two organizations were merged. In 1860 costs of Indian administration, previously borne by the British government, became the responsibility of the Province of Canada through the agency of the Crown Lands Department. At Confederation an Indian Affairs Branch was formed under the Secretary of State.[4] Section 29 of the establishing Act provided that the government at Ottawa "may authorize surveys, plans and reports to be made of any lands reserved for Indians" indicating the improved lands, forested areas and lands judged fit for settlement and "such other information as may be required". This provision has come down through the years in much the same wording in legislation except that in the 1952 version there is added the function of locating roads in a reserve. When the Department of the Interior was formed in 1873 the Indian Affairs Branch was transferred to it and the Minister of the Interior acquired the additional title from his cabinet colleague of Superintendent General of Indian Affairs. In 1880 Indian Affairs became a separate department of federal government but continued to report to Parliament through the Minister of the Interior.

From 1796 to 1866, and even later, numerous articles or deeds of agreement were signed between governments and Indian tribes under which lands, now in Ontario, were given up by the latter to the Crown for eventual settlement by non-Indians. In addition, between 1850 and 1923, a number of treaties of major significance were entered into on one hand by govern-

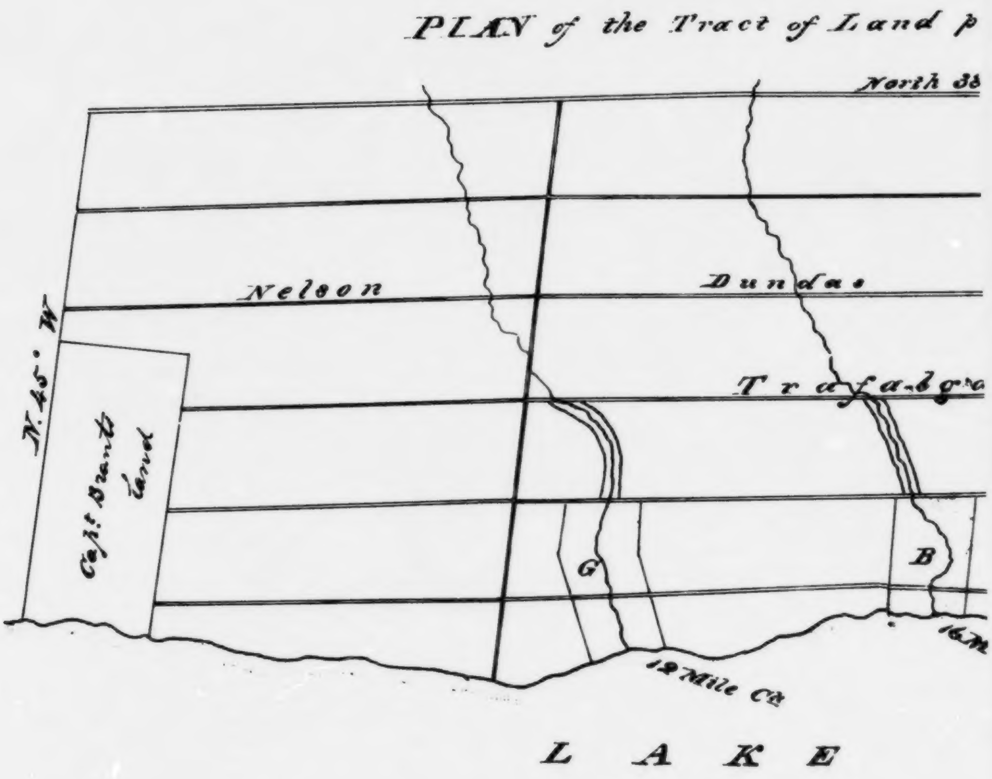

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FIGURE 119. Plan of trac

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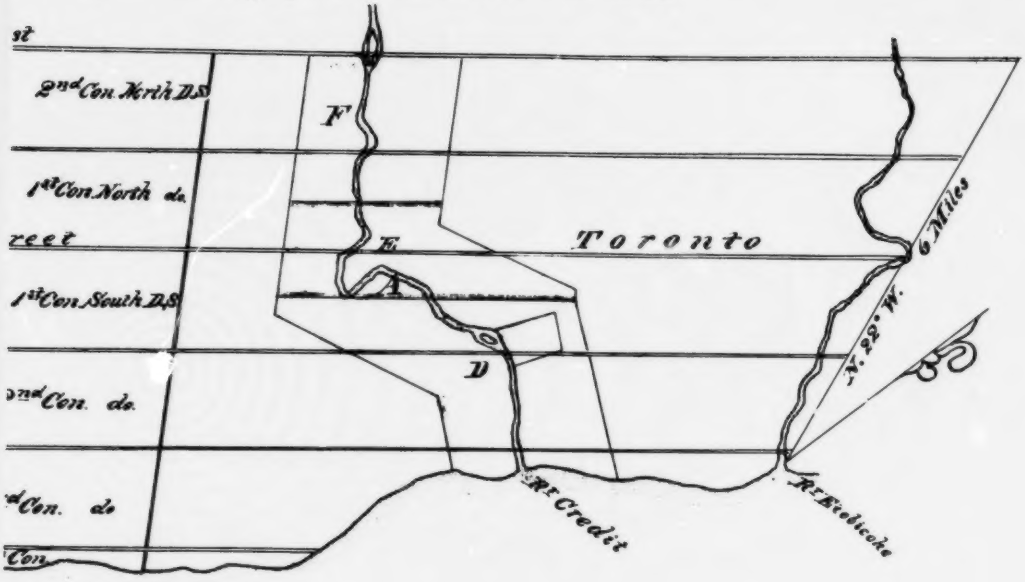
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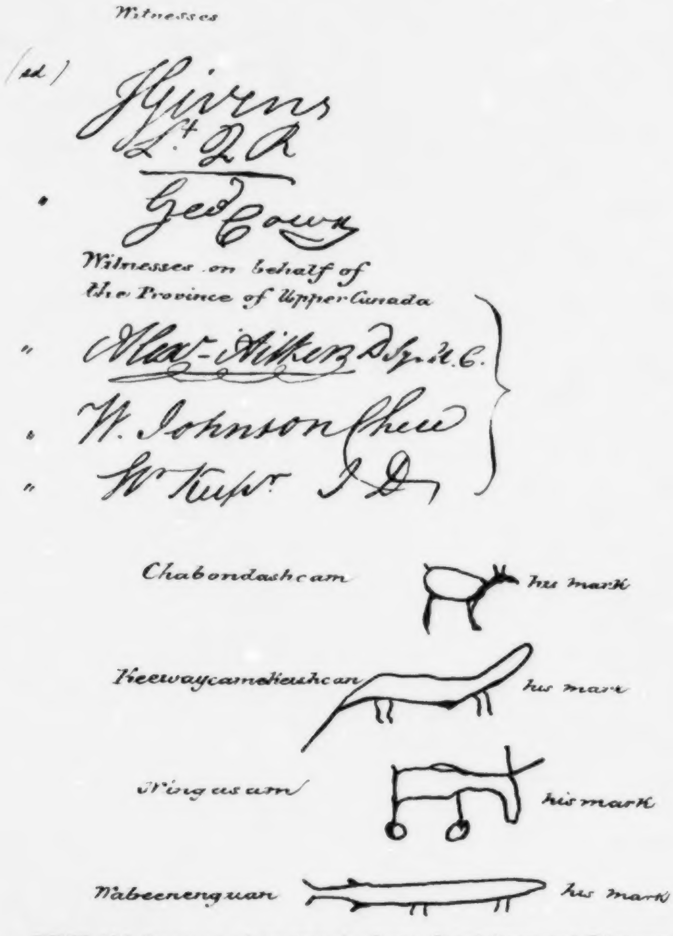
Survey Genl Office
York 22nd Jany. 1820

ian Affairs

purchased from Indians, 1806.

ments representing first, the Province and later, the Dominion; and, on the other hand, by native tribes. By these solemn transactions the surrender of the Indian interest in various territories was formally recognized and, in return, the Crown undertook to set aside lands as reserves for "the benefit and use of Indians". In various instances native peoples were also provided with benefits in the form of cash payments, annuities and educational facilities. Today, in Canada, about one-half of all Indians come under treaty terms.

Occasionally a treaty or agreement would refer specifically to the need for surveys. In the 1862 agreement creating a reserve for Ottawa, Chippewa and other Indians on Manitoulin Island, following the surrender to the Crown of the Indian title to that island in 1836, it was stated that "a survey of the said Manitoulin Island shall be made as soon as conveniently may be, by or under the authority of the Department of Crown Lands." After setting forth



Witnesses

(sd) J. Givens Lt. Q.R.

" Geo. Cowan

Witnesses on behalf of
the Province of Upper Canada

" Alexr. Aitken D.Sy. U.C.

" W. Johnson Chew

" Wm Kepr. I.D.

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FIGURE 120. Specimens of signatures by Treaty Commissioners and Chippewa Indian Chiefs on cession of Penetanguishene Indian Reserve, 1795.

the conditions for a subdivision of the island and the right of each Indian to make his own selection of any land on the island, it was provided further that "the selections shall all be made within one year after the completion of the survey . . . and plans of the survey shall be open to the inspection of all Indians entitled to make selections."[5]

Major treaties concluded with Canadian Indians, in chronological order, were the Robinson Superior (1850), Robinson Huron (1850), and Manitoulin Island (1862). After Confederation a series of numbered treaties of special importance were negotiated affecting, for the most part, Indians of the western interior. Treaty No. 1, for example, signed in 1871, concerned the Chippewa, Swampy Cree and other Indians in southern Manitoba. Treaty No. 7 (1877) related to the Blackfoot, Blood, Peigan, Sarcee, Stony and other Indians in southern Alberta. Treaty No. 9 (1905) concerned, however, the Ojibwa, Cree and other Indians in that part of Ontario drained into Hudson Bay. The latest treaty of this series, identified by numbers, was Treaty No. 11 (1921), relating to the Slave, Dogrib, Loucheux and Hare Indians located north of Great Slave Lake in what is now the Northwest Territories.

Details of arrangements made under these various and varied instruments differed with circumstances but, in the main, the size of a reserve was dictated by several factors, the most important of which was the total number of Indians to be accommodated on it. In the case of the numbered treaties grants of land were made on the basis of either 640 acres (one square mile) or 160 acres to each family of five. Other factors determining size of a reserve included the nature of the land itself, whether it was mostly rocky or largely arable, as well as the uses to which land would be put. If the reserve happened to encompass a small British Columbia fishing station only, then much less acreage would be required than if prairie farmland was being used.

In some treaties, such as the Robinson Huron document, the location and area of Indian reserves are fairly well defined. Under western interior treaties Indians would make their own selection of a territory attractive to them and a government survey of the land would follow. In treaties concluded with certain tribes in the Northwest Territories it was provided that "the Superintendent General of Indian Affairs shall depute and send a suitable person to determine and set apart such reserves . . . after consulting with the Indians concerned as to the locality which may be found suitable and open for selection".[6]

Almost every aspect of administration of Indian Affairs in this country, in the legal sense, encounters complications arising from the diverse origins of the reserves as well as from varying interpretations of treaty terms. Indian reserves came into being in a variety of ways, by treaty, surrender, order in council, purchase by the Crown, statutory grant and, in some instances, by their existence from 'time immemorial'.

Under the Act of Confederation the Parliament of Canada was given exclusive legislative jurisdiction over subjects enumerated in section 91. "Indians and Lands reserved for the Indians" was the wording of Article 24 of that section of the British North America Act. Accordingly, in 1867, the five provinces of the union transferred to the new Dominion some 119 separate areas as reserves. Quebec and New Brunswick each transferred 19; Nova Scotia 30; Prince Edward Island 2, and Ontario, about 49.

In British Columbia the administrative structure in regard to Indian reserves was peculiar to that province in as much as reserves fell into two main categories, those within and those outside the Railway Belt. But it was not until 1913, by Orders in Council beginning with P.C. 205, that the federal government formally withdrew such areas from settlement by non-Indians.

By the time of the First World War the 119 or so Indian reserves in existence in the five original provinces forming Confederation had increased in number to 1,625 within the then nine provinces and two territories and of that total 1,158 were located in British Columbia.

Surveyors were instructed from Ottawa, when engaged in subdivision work within the reserves, to make careful note of all Indians in occupation of lands, listing names and recording the particular quarter-sections or other acreages on which they resided and indicating whether or not they were treaty Indians. Statutory declarations were not to be taken from Indians but a special report was to be made by the surveyor, accompanied by a sketch showing in each case all improvements made to properties.[7]

One of the earliest post-Confederation surveys on record of Indian reserve lands in Ontario was performed on Manitoulin Island in 1877 by Dominion land surveyor George B. Abrey. In the same field season instructions were issued by the Surveyor General of Canada for the location and survey of a reserve for the Sioux band of about twenty families residing near the international boundary at Turtle Mountain, Manitoba. This task was carried out in 1879 by John McAree as section 31 of a township survey in that area. Also in that season a total of 22 other Indian reserves were surveyed under the terms of Treaties Nos. 2, 3, 4 and 5.

It was in 1877 also that a pioneer in the surveying of Indian reserves became active in Manitoba. John L. Power O'Hanly, after conferring with the Acting Superintendent of Indian Affairs, left Winnipeg for the field on July 14, accompanied by George Parsons and J. M. O'Hanly. At the estuary of the Berens River, which flows into Lake Winnipeg from the east, O'Hanly met Chief Jacob Berens of the local tribe and asked him to point out where he wanted his reserve located. A solemn conference with a number of prominent members of the tribe followed this request. O'Hanly read the treaty text, carefully explaining its terms with the aid of an interpreter. In his field journal O'Hanly described the subsequent discussion carried on "in primitively grave fashion". The Indians wanted the Grand Rapids site on the west side of Lake Winnipeg, rather than the site at Berens River or, for that matter, any other site. At this point in his report O'Hanly wrote that he decided "it was better to abstain from laying out the reserve as originally contemplated" in order to leave the final decision on this momentous issue to the judgment of the Superintendent General of Indian Affairs.

The tribal representatives considered that the allotment of 160 acres for each family of five was inadequate. O'Hanly referred them to the precise words of the treaty and reminded them that he had "not come to make or modify the treaty . . . I must proceed to lay out the reserve in conformity thereto". The surveyor assured the natives, however, that he would make known their representations in the proper quarters but that he now wished them to show him where they wished their reserve to be laid out and if they refused or neglected to make known their choice then "I would proceed to lay it out as I thought best."[8]

The Indians, finding O'Hanly resolute, became more cooperative. On July 26 lines were laid down by the surveyors, defining reserve boundaries and this work was completed on August 17. One passage in O'Hanly's report is of special interest. "From my own observations", he stated, "I consider the departmental map of Lake Winnipeg surprisingly accurate. At each Reserve I made a series of astronomical observations from determining the latitude and variation of the magnetic needle, a detailed record of which, with the computations, is attached. I had no opportunity of finding the longitude at either place, and experience had led me to place little confidence in observations made for this purpose with ordinary surveying instruments and watch. I used a six-inch transit-theodolite for observing and a railroad transit in the field."

Another notable early surveyor of Indian reserves in the western interior was William Ogilvie. On May 20, 1878, Ogilvie left Ottawa, bound for Winnipeg. He arrived at that destination ten days later and lost little time in hiring an assistant surveyor, three helpers and a cook. In addition he acquired for the season four horses and carts along with suitable outfitting. The party left Winnipeg on June 4, arriving in Battleford one month later. During the season's travels Ogilvie and his survey party in early September reached Blackfoot

Crossing, in what is now southern Alberta. There he found many Indians gathered for a treaty payments ceremony. In his field book Ogilvie related that the Indians congregated there had been informed previously of his coming "and some parties either ignorantly or maliciously told them that I was coming to mark out a small piece of land around the Crossing on which they were to be shut up and compelled to devote themselves to agriculture. Not knowing anything to the contrary they were, of course, very much incensed. I immediately sought an audience with Crowfoot, the head chief of the Blackfoot tribes and explained fully and clearly to him the object of the survey which put him and his people in good humor and from the time I commenced the survey until I finished I was not interfered with in any way by the Indians".[9]

This was a considerable triumph in diplomacy but Ogilvie's troubles were not over. After completing the survey of that part of the Blackfoot Reserve located above the crossing Ogilvie began the long return trek across the bleak prairies. The weather had continued to deteriorate rapidly and in early December party rations ran very low. After having been driven at a fast pace for three days his horses, as he put it, "began to fade out". For days Ogilvie and his men had nothing to eat other than small quantities of dried apples and rice. "The day after our departure from Qu'Appelle the axle of our waggon broke and we lost a day searching for and making a new one but the following morning the new one broke after going about three miles. As we could not find any wood strong enough to make one that would stand, we had to abandon the wheel and make sleighs . . . ". On December 30, 1878, the party reached Winnipeg and its members were paid off and discharged for the season.

During the 1878 field season instructions had been issued by the Indian Affairs Branch, Department of the Interior, to the Department of Crown Lands in Quebec to have boundaries surveyed of a five-mile-square reserve on the St. Maurice River. This was one of a number of Indian reserves created under the 1851 statute but which had never been surveyed. Two reserves in Cape Breton county near Sydney, Nova Scotia, containing about 3 and 536 acres respectively, were surveyed in that same year and steps taken to have the land transferred from Crown Province to Crown Canada for the use and benefit of the Indian occupants.

FIGURE 121
Hon. E. Dewdney.

Even after the conclusion of a treaty it was not always an easy matter to win over Indians to the idea of settling on reserve lands, let alone to induce them to make a choice of location. Hon. E. Dewdney, as Indian commissioner in 1883, was to discover this melancholy fact. In October of that year he mournfully reported from Regina to the Superintendent General of Indian Affairs in Ottawa:

"The large sum expended last year in assisting Indians to remove their reserves was, to a great extent, thrown away . . . These Indians, until lately, made the Cypress Hills their point of rendezvous and . . . were constantly tempted to make incursions across the border into the camps of United States Indians on horse-thieving expeditions . . . I decided to make another effort to disperse these bands and endeavor to get them to move to those sections of the Territories which they had formerly claimed as their own and had ceded under treaty to the Dominion.

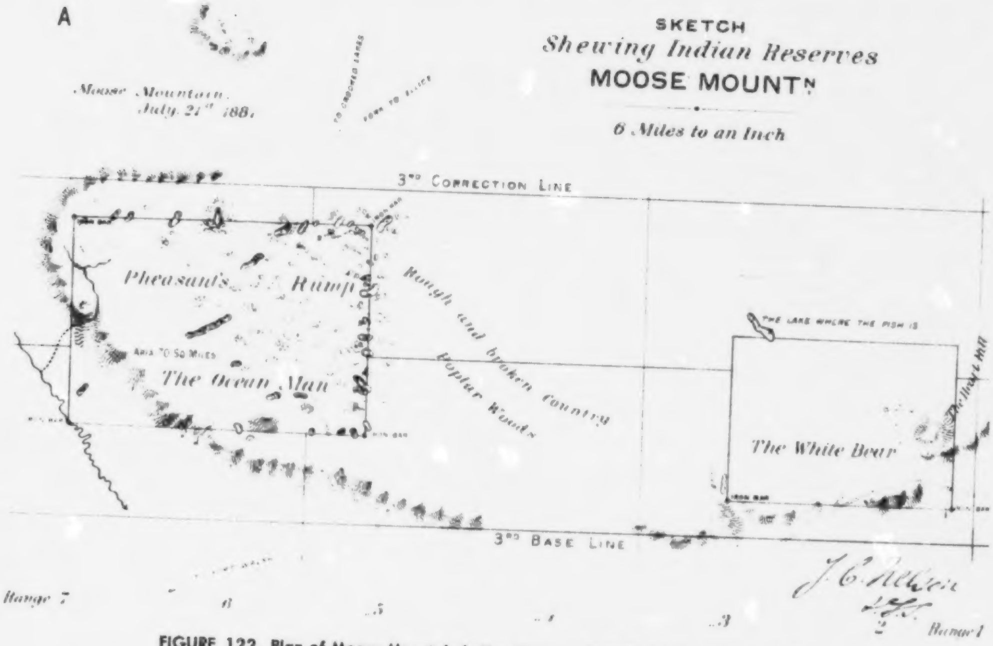
"On being approached in this direction it was discovered that they were desirous of procuring fixed ammunition, of making one final horse-stealing expedition across the line in all the force at their command, return with as many scalps as possible, then after a certain delay, acquiesce with our wishes. Their requests were refused . . . and after two months constant talking and urging, the second of July saw all but some 120 lodges of recalcitrants with their backs towards the hills on the trails leading to their respective reserves."[10]

In the western interior of Canada, in addition to O'Hanly, Ogilvie and McAree the names of a number of other Dominion land surveyors stand out in the records as pioneers in surveys of Indian reserves. Most of these surveys occurred in the 1880s. John Charles Nelson, George Albert Simpson, Archibald W. Ponton, William Wagner, William A. Austin, C.E., Edgar Bray, C. F. Leclerc, Elihu Stewart, Allan Poyntz Patrick, John Lestock Reid, William Pearce and George A. Bayne were prominent among these hardy and resourceful trailbreakers.

Simpson encountered a singular lack of helpfulness on the part of some Indian chieftains of the western interior. When, in the summer of 1880, Simpson was endeavoring to survey Chief Woodpecker's reserve south of Fort Edmonton that Indian leader stopped proceedings by removing the survey instruments. Apparently he felt that the area allotted to this reserve was inadequate. Only five miles of the south boundary remained to be run at the time of the interruption. Later in the same year at Edmonton the chief's brother approached Simpson, asking that the survey be completed and expressing deepest regret on behalf of the chief and band for previous behavior and making extravagant promises as to their future good conduct.[11]

Simpson reported to Dewdney at Ottawa on his field season of 1881 that in mid-April he had broken up his winter camp and left to survey a reserve for Chief Moosomin, who had located himself, in accordance with Treaty No. 6, some 12 miles west of Battleford on the North Saskatchewan River. "On account", Simpson wrote, "of the chief's stubbornness and cloudy weather" work was not started until near the end of April. By mid-June Simpson had undertaken a four-day survey of a reserve on the South Saskatchewan River for Chief White Cap and his band. In eloquent terms the chief deplored the decline in Indian population in the west "whose numbers were [once] as the blades of grass and whose lodges covered the prairie". This reserve was resurveyed by Nelson seven years later. Simpson also reported that, as the third principal meridian ran through Chief One Arrow's reserve, land to the west of this line had been subdivided "as it is always desirable to locate the Indian reserves so as to agree as far as possible with the survey of Dominion lands".[12]

Austin, in that same season, entered the woods at the base of Moose Mountain on June 29 and visited Chief White Bear's reserve at the Heart Hill. Under the terms of Treaty No. 4 the geographical position of the reserve was fixed by him and iron bars planted at its southeast and southwest corners in accordance with the wishes of the Indians. "They are very proud", Austin commented, "of having the corners of their estates marked by iron posts like the


A
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Moose Mountain.
July 21st 1881
3rd Correction Line
Pheasant's Rump
Area 70 Sq Miles
The Ocean Man
Rough and broken Country
Poplar Woods
The Lake where the fish is
The White Bear
3rd Base Line
J. C. Nelson
Range 7
6
5
4
3
2
Range 1

FIGURE 122. Plan of Moose Mountain Indian Reserve, N.W.T., 1881, by J. C. Nelson.

white man".[13] Four years after this survey Austin was promoted to the post of Surveyor and Chief Draughtsman at Indian Affairs headquarters in Ottawa.

In early September, 1881, Nelson arrived at Nut Lake in what is now the province of Saskatchewan. He reported that "the Indians of Yellow Quill's band had been away all the summer at Qu'Appelle to see His Excellency and to receive their annuities . . . On the following day I was visited by a section of Yellow Quill's band, headed by his brother, who is said to be a bitter enemy of that chief. This Indian informed me that they did not wish to have any surveying done in the country and they were much dissatisfied. I explained to him the objects of the survey and how desirable it was that they should direct their attention to farming operations . . . They subsequently assented to my going ahead with the work. After the pow-wow I was informed by them that a small present of tea and flour was customary on such occasions and would be most acceptable. I gave them a small quantity of these commodities and reminded them that they had forgotten to ask for some tobacco and sugar . . . The survey of Fishing Lake Reserve was completed on September 29 and the bell mare had a colt which caused a great commotion among the mules".[14]

John C. Nelson who, in 1889, prepared for Dewdney a most useful volume of descriptions and plans of Indian reserves in the western interior, is on record as well concerning some extreme weather conditions faced by him and his party in the 1882 field season on the prairies. On May 20 they experienced a severe snowstorm, preceded by a high west wind and followed by a hard frost. Water in a pail outside Nelson's tent was frozen to the depth of one inch. Snowdrifts were piled high on all sides. Nelson observed that many birds were frozen to death in that fierce and most unseasonable storm. Nelson's report continued:

"On the 24th the party started for Muskowpeetung's to complete the survey of the reserve for his band. At this time my mules were all more or less attacked by mange, a fact I first discovered after they swam the Qu'Appelle River. A few washings with carbolic acid soap and the application of a mixture of train oil, sulphur and turpentine completely extirpated these pernicious parasites."

In another part of his report for that season Nelson commented that "although it is desirable to locate the boundaries of the reserves so as to coincide with the legal subdivisions of the Dominion Lands Surveys still, in this case, it was not practicable to do so, and at the same time meet the wishes of the Indians, who preferred to have the rear, or south, boundary a straight line as shown on the plan".

Surveying Indian reserves in British Columbia began in earnest in the late 1870s. In a report to Sir John A. Macdonald, the then Superintendent General of Indian Affairs, concerning the year ended June 30, 1878, note is made of the activity during the early part of that summer of two survey parties on Vancouver Island under the leadership of Edward C. Mohun, C.E. These were surveys to establish boundaries of reserves as decided upon by Indian commissioners in 1877. Survey work on the mainland was in the hands of Capt. William S. Jemmett, R.E. and Ashdown Henry Green, R.E. All three men had been authorized, prior to 1891, to practise in the coast province as fully qualified land surveyors. Jemmett, in his diary of the 1881 season, reported laconically "June 3: Finished reserve at 1 p.m. in beaver dam, 4 feet of water. Hot day. Chained a mile checks . . . river much swollen. Return to main reserve at 4.30 p.m.".

Another noted surveyor of Indian lands in early days in the coast province was Ernest Meeson Skinner who reports in his diary of May 25, 1885: "Went down to Skoon Koonh [Skoonkoon] and looked over land which is worthless. Heavy storm came on, came back and finished Reserve at 79 mile post. Had to give much more land than was at first supposed, to include graves. Land is good for nothing, most of it is old river bed and slide from opposite bank".[15]

Indian reserves in British Columbia took many forms and represented a variety of functions. Sometimes these special areas enclosed one tiny fishing station, another, a few small islands, on occasions a graveyard, some oyster beds or a village. In addition to original surveys of these properties, as well as other much larger areas, any increase or decrease in the size of such reserves called for additional survey work.

The Indian Superintendent in Victoria informed Sir John A. Macdonald in 1880 that "Indians who have reserves surveyed are very anxious to have these marked off, and divided into individual allotments. I think it is very desirable that this should be done, and it will constitute one of the first and most important duties of local agents to be appointed in the province. A great stimulus will be given to the industrious Indian by giving him a tract of land and defining its boundaries within which he may recognize his own estate. I know of no plan more calculated to discourage barbarous customs which tend to destroy individuality, or to induce the improvement and general cultivation of their reserves. The first and distinguishing principles of civilization, no doubt, consist in the recognition and protection of individual property rights . . . ".[16]

The experiences of most of the early surveyors of Indian reserves in this country, as recounted in their journals and diaries, indicate that the functions of survey party chiefs were not, in pioneer times, confined to purely surveying operations. They were, in fact, called upon to serve in a variety of important roles. They acted as negotiators, interpreters, mediators and census takers. They were called upon frequently to advise Indians on such matters as soil comparisons, land values and the ultimate precise location of reserves in order that maximum advantage would redound to Indian occupants from actual surveys. On the whole, members of the surveying profession discharged their varied, important and sometimes highly sensitive tasks with tactfulness and understanding, blended with firmness when that quality of character was required. In this field of public service surveyors made a worthy, lasting contribution, at a critical stage in the development of the nation, to the peace, order and good government of Canada and to the ultimate well-being of its Indian population.

18

THE GEOLOGICAL SURVEY OF CANADA: FIFTY YEARS OF MAPPING: 1867-1917

In 1868, the year before he ended his 26-year term as first Director of the Geological Survey of Canada, Sir William Logan (1798-1875) made a topographical survey of the Pictou coalfield in Nova Scotia. Despite his retirement from leadership of the organization Sir William maintained an active interest in mapping. Until 1874 he continued map work by himself in the Eastern Townships, a task he had commenced in 1848. Others in the Survey organization, such as James Richardson and Arthur Webster, were engaged from time to time during this period in the same region. The paced measurements of roads and of exploration lines by these three men totalled about 17,000 miles and covered an area of 26,380 square miles.[1]

FIGURE 123
A. R. C. Selwyn.

Logan's successor, Alfred Richard Cecil Selwyn (1824-1902), was confronted, after 1871, with a survey problem of awesome dimensions. Vast territories in the western interior had been acquired by Canada from the Hudson's Bay Company in addition to the newly-joined provinces of Manitoba and British Columbia. Selwyn, at the outset of his term of office, presided over a staff of only five geologists, namely, Edward Hartley, Robert Bell, James Richardson, Charles Robb and H. G. Venor. Other staff members included T. Sterry Hunt, mineralogist; E. Billings, palaeontogist; and two draughtsman-topographers. An artist, Horace Smith, and a museum preparator, T. C. Weston, completed the tiny organization. Under Selwyn the staff was expanded substantially by the addition of a number of men of outstanding ability. Among those who were attracted to the Geological Survey during Selwyn's administration were G. M. Dawson, A. C. Lawson, R. G. McConnell, J. B. Tyrrell, A. P. Low, R. W. Ells, Willian McInnes and A. E. Barlow. In this chapter it is possible only to summarize the extensive surveys of these and other scientists by selecting individual achievements that are fairly representative of the nature and immense scope of all the work performed.

With Richardson as assistant Selwyn travelled in the interior of British Columbia from late July to mid-November in 1871 on the heels of engineering parties searching for the most advantageous rail route through the Rocky Mountains. The mission of the two men was to investigate the geology and mineral resources of the areas being probed by the engineers. It was during this survey that Selwyn, on one memorable occasion, discovered that his hungry horse had eaten his priceless notebook.[2]

Selwyn also instigated systematic mapping of the Maritime Provinces and of southern Quebec, also gathering information on the mineral resources and natural history of these regions. On three of his early expeditions he was accompanied by John Macoun, the eminent botanist. Selwyn was keenly interested in the expansion of museum contents and facilities. When the head office of the Survey was moved from Montreal to Ottawa in 1880 he reported on the transfer of 1,729 boxes, 101 barrels and 162 packages of specimens, the complete shipment weighing 282,585 pounds.

During the first 53 years of its existence the principal direction and administration of the Geological Survey of Canada was shared over nearly equal terms of office by Logan and Selwyn. Under their able, farsighted supervision the organization was given a sense of direction, a loftiness of purpose and a strength of impetus that has since continued to feature its growth and increasing usefulness. The story of these formative years would be quite incomplete, even in a relatively brief chapter, without special comment on the brilliant careers in the federal service of Joseph Burr Tyrrell (1858-1957) and Alfred Ernest Barlow (1861-1914). Tyrrell, appointed to the Survey in 1881, became Dawson's assistant when, two years later, they explored and mapped the Rocky Mountains region between the 49th parallel and the Red Deer River. Dawson, Tyrrell and McConnell, in the mid-1880s, conducted extensive surveys in the western interior and their work was published, on a scale of 8 miles to the inch, in maps of the Bow and Belly river regions, Cypress Hills, and what is now northern Alberta, covering an area of 100,000 square miles.[3]

Tyrrell's chief claims to fame as a reconnaissance surveyor derive, however, from his epochal journeys in the Barren Lands in 1893 and 1894. On the first of these missions he was accompanied by his brother, James William Tyrrell (1863-1945), who acted as topographer and who later wrote a book on his experiences during this expedition.* After graduating from the School of Practical Science, Toronto, in 1883, J. W. performed topographical and geological surveys in the vicinity of the Lake of the Woods as assistant to A. C. Lawson in the compilation of maps published on a scale of 2 miles to the inch. Following this project Tyrrell was appointed a hydrographer and weather observer on the vessel *Alert* that transported the federal government expeditions of 1885 and 1886 to Hudson Bay and prepared related maps. A Dominion and Provincial (Ontario) land surveyor, J. W. Tyrrell was appointed Engineer and Surveyor for the city of Hamilton in 1888. At the turn of the century he made a report to the Surveyor General, Ottawa, on his explorations of the season of 1900 between Great Slave Lake and Hudson Bay. He prepared a large sheet map of the country traversed. In seven months Tyrrell travelled 4,600 miles although his actual survey extended to 1,729 miles only. He brought back with him, after numerous privations, about 100 photographs, a large number of astronomical and magnetic observations together with some notes and specimens of rock formation and minerals.[4]

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*"Across the Sub-Arctics of Canada" J. W. Tyrrell, C.E., D.L.S. Wm. Briggs, Toronto, 1897.

FIGURE 124
J. B. Tyrrell.

On the first of the two journeys made by J. B. Tyrrell into the northland he and his party, travelling in three canoes manned by six crewmen, descended the Athabasca River and surveyed the north shore of Lake Athabasca by boat-log and solar compass. Their instructions were to conduct an exploratory survey of the Barren Lands, then a largely unknown area of some 200,000 square miles lying north of the 59th parallel between Great Slave Lake and Hudson Bay. Although the party's topographer mentions that some crude sketch maps were obtained from local Indians, it is likely that for guidance the group placed more reliance on the rather imposing collection of instruments taken along, namely, one sextant, one solar compass, two pocket compasses, one prismatic compass, one fluid compass, two boat-logs, two chronometers, one aneroid barometer, one pocket chronometer and three good watches.

From Black Lake, just to the east of Lake Athabasca, the party ventured northeasterly toward Chesterfield Inlet, reaching its shores on September 12. The last stage of the trip, down the open coast, from the Inlet to Fort Churchill, proved to be the most dangerous and trying experience of all the men had endured. Provisions ran low and opportunities to obtain game were scanty. Snowstorms, menacing ice formations, sickness, and frostbite plagued the members of the expedition at this point. An utterly exhausted group finally reached their destination on Hudson Bay. When sufficiently rested the party continued on by snowshoe and dogteam, reaching West Selkirk on January 1, 1894, en route to Winnipeg. They had survived a gruelling 3,200-mile journey that had commenced on May 30 of the previous year. The topographic map, 25 miles to the inch, accompanying the Tyrrell report of 1896 was compiled by D. B. Dowling.

In the summer of 1894 J. B. Tyrrell embarked on a second expedition to the Barren Lands, travelling to Kasba Lake by way of Reindeer Lake, then down the Kazan River. Avoiding Chesterfield Inlet on this trip the party portaged to Ferguson River, descending that stream to Hudson Bay. The canoe trip along the open coast to Churchill was repeated and that port reached on October 1. These two journeys into the Barrens in successive years provided much geographical and geological information. It was established, for example, that in the Pleistocene age a centre of glaciation existed west of Hudson Bay from which a continental ice mass, now known as the Keewatin Glacier, extended in all directions. The distance surveyed by the two Tyrrell expeditions totalled 2,900 miles, of which 1,312 miles were travelled by canoe. Distances obtained were checked by numerous observations for latitude.

J. B. Tyrrell retired from the Geological Survey in 1898 to become a leader in the Canadian mining industry as well as in other varied fields of activity. He became President of the Champlain Society, the Royal Canadian Institute and the (Royal) Canadian Geographical Society. The Tyrrell Medal of the Royal Society of Canada is awarded annually for the best historical work published in this country. In 1905-06 his brother served a term as President of the Ontario Land Surveyors Association.

Another pair of brothers, along with their father, made notable contributions to Canadian geological surveying and related topographic mapping. The father, Robert Barlow, R.E., and a son, Scott Barlow, were appointed to the Survey staff by Logan. Robert Barlow's contributions to the 1863 geological map of Canada helped to make it one of the most interesting and useful examples of Canadian cartography up to that time. Another son, Alfred Ernest Barlow (1861-1914) studied geology under Sir J. W. Dawson at McGill University. He proved to be a brilliant student and won the Logan Medal. In 1883, the same year in which G. M. Dawson was made Assistant Director of the Survey, A. E. Barlow joined its staff.

In work that spanned a quarter-century, performed mostly in Ontario, A. E. Barlow left an indelible impression upon the history of Canadian geological surveying and mapping. He was an able topographer, as evidenced by the results of his investigations published in 1910. In the year following his admission to the Geological Survey of Canada Barlow, Ellis and Giroux made chain and paced surveys totalling 1,003 miles in order to complete information for publication of the Cumberland, Nova Scotia, coalfield map, a project started by Scott Barlow some years previously.[5]

In 1885 Barlow assisted A. C. Lawson in making a detailed mapping survey of the Lake of the Woods and Rainy Lake areas as well as along the Winnipeg River, for publication on a scale of 2 miles to the inch. In 1888 to 1891 Bell and Barlow completed information for the Sudbury and French River sheets. In the seasons of 1892 and 1893 Barlow, with W. A. Johnston as his assistant, surveyed the western portions of Lake Nipissing and roads in the Nipissing and Temiscaming map-areas, totalling 1,295 miles. In 1895 he did similar work in the Pembroke and Cornwall districts and, for the following four seasons, he was engaged in mapping and detailed geological studies of the Haliburton and Bancroft districts. At the turn of the century Barlow made examinations of the nickel and copper resources of the Sudbury area.

On the retirement of Selwyn it was natural that George Mercer Dawson (1849-1901), who had served as Chief Geologist and as Assistant Director of the Survey since joining the staff in 1875, should become its Director. This latter promotion took place in 1895. His untimely death in Ottawa, only six years later, was widely mourned. Though his term as Director was relatively brief, Dawson proved to be, in every respect, a worthy successor to Logan and Selwyn.

The twenty years Dawson spent in the field were remarkably fruitful. His precise, first-hand knowledge of the far west and northwest of Canada and the effectiveness with which he disseminated that knowledge was unmatched in his day. His fame is fittingly perpetuated in the name of Dawson "City", the important and historic community so closely associated with the mining industry of the Yukon since its infancy. "Doctor George", as he was familiarly known, was not only an eminent geologist but as well a foremost naturalist, ethnologist and palaeontologist, in addition to being a prolific collector of specimens.[6] In addition he hammered away intelligently and persistently at problems of administration and of pure geological science. His reports, maps and papers are models of careful description and lucid exposition. Dawson's contributions to the literature of geology and other sciences in Canada are illuminating in content and far-ranging in scope. When he functioned as Acting Director of the Survey during an extended absence of his chief, Selwyn expressed in writing his "high appreciation of the very valuable and efficient manner in which Dr. Dawson has performed all the work".

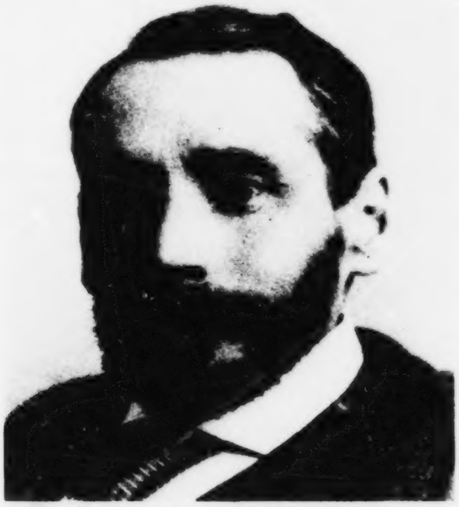

FIGURE 125
Dr. G. M. Dawson.

Dawson's topographical work ranged over the entire region from Cypress Hills in the western interior to the Queen Charlotte Islands and from the 49th parallel to Yukon Territory. His achievements in the interior of British Columbia were especially noteworthy. In the seasons of 1875-76, for example, he surveyed trails, lakes and streams in the largely unexplored area between the Fraser River and the Coast Range. In 1879 he made a traverse from the Skeena River to Edmonton. From 1888 to 1890, with his topographical assistant, James McEvoy, he resurveyed the country depicted on the Kamloops map sheet. A network of triangles, based on the Canadian Pacific Railway and other surveyed lines, was established between points, each of which was occupied as a transit station and sketching place, elevations being determined barometrically and by angles of elevation. Other topographic details were filled in from paced and track surveys, checked by latitude determinations. During the same two-year period Dawson made surveys with boat-log of the Arrow Lakes and the northern part of Kootenay Lake.

Any map by Dawson had the reputation of being as good as a "well-defined trail, a literal photograph of the country and containing information phenomenally complete and accurate". His surveys achieved a high degree of excellence partly because he made great exertions and underwent severe physical ordeals in order to get all the facts possible and to verify such information by personal observation. Short of stature and frail in appearance, Dawson nevertheless accomplished astounding feats of endurance in the field. Afflicted by a chronic chest weakness, and with his back humped by a boyhood mishap, he somehow contrived to rival the Indians in surmounting extreme hardships in the wilderness without complaint. A cheerful, amiable disposition, combined with an indomitable will and an insatiable passion for exploration and discovery, helped sustain Dawson through the most strenuous adventures.

There was something also of the poet and minstrel in Dawson's soul. From time to time he committed to his field journal and other records fragments of verse that reveal his basic views on life. His innate sense of humor flashes brightly through lines he penned in awe of that tireless tormentor of surveyors through the ages on this continent, the ubiquitous mosquito. The verse concludes,

"Oh smudge, oh glorious smudge,
let me entrench in thy noxious cloud
and nose and eyes all smarting from the stench,
then comes the winged crowd!"

On occasion his verse had a distinct geological flavor. In the wilds of British Columbia he was inspired to write:

"Contorted bed, of unknown age,
My weary limbs shall bear,
Perhaps a neat synclinal fold
At night shall be my lair.
Dips I shall take in unnamed streams,
Or where the rocks strike, follow
Along the crested mountain ridge
Or anticlinal hollow . . .
Where long neglected mountains stand
Just crumbling into shreds
And laying bare on every hand
The treasures of their beds."[7]

The fame of this versatile surveyor-scientist, administrator and author lives on not only in the name of Dawson in Canada's northland but as well in the names of a Manitoba bay, a British Columbia glacier and mountain, and the Dawson Range in Yukon Territory.

Dr. Dawson was succeeded by Dr. Robert Bell (1841-1917) as head of the Survey. At the age of 15 Robert Bell had worked with one of Richardson's survey parties in the Gaspé Peninsula. In fact, for several summer seasons thereafter the young student worked for the Geological Survey of Canada in the same region. Bell also worked in western Ontario in the 1870s where he continued topographic mapping begun by Murray. He explored Manitoulin Island and the north shore of Lake Huron as well as working with Selwyn along the English and Winnipeg rivers. In fact, there were not many areas of Ontario that he failed to visit and examine during the last three decades of the 19th century. In 1878 he received his Doctor of Medicine and Surgery degree from McGill University. In the seasons of 1895-96 Dr. Bell was in Labrador, part of the time with Brock.

In the field Bell's regime was Spartan-like and the story is told by his canoeman, likely an apocryphal yarn, that on one occasion when the survey party had reached civilization after a long period in the wilderness it pitched camp not far from a store. For weeks beans, bannock and fish had formed the staple, and often the only, items of diet. The cook of the party expected something of a more exotic nature to be added by the chief to the evening meal in view of their happy proximity to a source of more varied food supplies. Dr. Bell, at an appropriate moment during the preparations for the drab repast, dramatically announced, "Joe, the boys have had a long, hard trip. They have worked well and I think we ought to give them a treat tonight. *Here is a can of tomatoes!*"[8] (author's italics)

During Bell's term as Acting Director of the Survey from 1901 to 1906 emphasis continued to be placed on exploration, with increased attention to the geological investigation of mining areas.

The name of Albert Peter Low (1861-1942) has become almost synonymous with Labrador, the geological and other resources of which were explored, reported upon, and mapped by him so accurately and so extensively in the 1890s. A graduate with honors from McGill University, Low joined the Geological Survey staff in 1882 and began a career as a member of that organization covering a quarter-century and culminating in his appointment as Director in 1906.[9] In two principal ways Low's brief period as Director of the Survey was noteworthy. First, he raised qualifications of technical personnel by setting higher standards for admission to the ranks of the Geological Survey of Canada. Second, during his term of office a new federal government department was formed, the Department of Mines. It consisted of a Mines Branch and the Geological Survey, and the new organization reported to the Minister of the Interior.* Although his health was beginning to deteriorate, Low was named first Deputy Minister of the Mines Department and this appointment terminated his service as Director of the Survey after 19 months in the post. He retired from the public service in 1913.

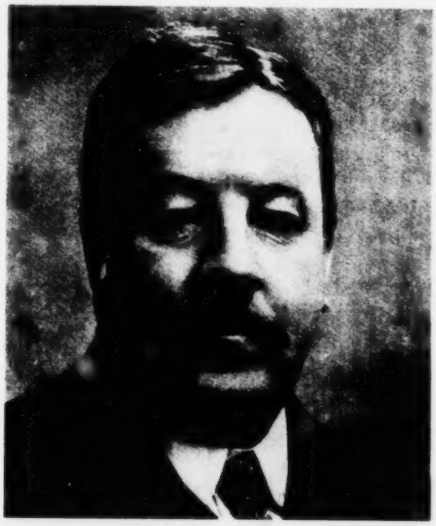

FIGURE 126
A. P. Low.

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*In accordance with Chap. 29, Statutes of 1907, and by Order in Council P.C. 1184, the Department of Geological Survey was abolished as a separate department, and from May 3, 1907, formed part of the new Department of Mines.

In Low's first season with the Survey he was assistant to R. W. Ells in the Gaspé region. By 1885 he was engaged in highly important surveys on his own responsibility but not before undergoing a unique physical test. In the previous year a joint federal-provincial expedition had been sent to Lake Mistassini in central Quebec, the head of Rupert River. John Bignell, a land surveyor, represented the province of Quebec. The party arrived at the Hudson's Bay Company post on the lake on December 23. The last ten days of the journey involved travel by snowshoe on low rations and in temperatures ranging to 40 degrees below zero. Arguments occurred during the winter over whether Low or Bignell was party chief. In order to clarify the situation Low packed his toboggan, donned snowshoes and set out for Ottawa. The outward trip took him from February 2 to March 2 to complete. Armed with a letter from his superiors placing him in full charge of the expedition Low returned to the field party, five arduous weeks after leaving the capital. That summer the survey of Lake Mistassini was completed, after which Low descended Rupert River to James Bay.[10]

Low is best known, however, for his geological investigations in Labrador extending over eight consecutive seasons from 1892 to 1899. In several of these seasons D.I.V. Eaton, C.E., acted as Low's assistant and topographer. Low is on record as stating in characteristically generous fashion that "it is entirely to Eaton's careful work that the exact surveys of these years are due. Mr. Eaton, since his return to Ottawa, has compiled the map which accompanies this report".[11] In the initial season of this series of surveys Low and his party crossed from Lake St. John to Lake Mistassini and from there to James Bay by way of the Upper Rupert and Eastmain rivers. The summer of 1894 was occupied in mapping lakes and streams in the headwaters region of Hamilton River. During the seasons of 1893-94 Low travelled 5,460 miles, 1,000 of this total on foot.[12]

In the following season Low made his way along the Manicouagan River, involving passage through a narrow, perilous, 45-mile-long gorge where portages were impossible and rapids continuous. At this stage of his narrative Low reports that "while descending this portion of the river, owing to the accidental upset of a canoe, one of the Indian guides named Paul Bacon was reported drowned in the heavy water . . . ".[13] Above Lake Mushalagan Low reported "some thirty miles . . . of crystalline limestones are developed in great thickness . . . There is an extraordinary band of iron which appears to belong to the beds associated with the limestone". Low, in fact, made known for the first time that from the upper reaches of Hamilton River to Koksoak River there was a belt of stratified rocks containing high-grade iron ore estimated in millions of tons.[14]

Within a span of 12 miles Hamilton River drops nearly 900 feet. Low, in his official survey report of 1895, displayed marked literary talent in his graphic description of "one of the greatest and wildest descents of any river in eastern America". The final 300 yards of rapids above Grand Falls of the Hamilton are, in Low's words, "down a very steep grade, where the confined waters rush in a swirling mass, thrown into enormous long-surging waves, at least twenty feet from crest to hollow, the deafening noise of which completely drowns the heavy boom of the great falls immediately below. After a final great wave, the pent up mass of water is shot down a very steep incline of rock for 100 feet, where it breaks into a mass of foam, and plunges into a circular basin below, the momentum acquired during the first part of the fall being sufficient to carry it well out from the perpendicular wall of rock at the bottom, leaving almost a free passage between the foot of the cliff and the falling water. The total fall from the crest of the incline to the basin below is 302 feet. The Indians believe that the space between the falling water and the rocky wall is occupied by the spirits of two maidens who were accidently carried over the falls, and who now pass their time in dressing and preparing deer skins. On this account, or more probably because of the feelings of awe inspired by the grandeur of the surroundings and the enormous power displayed in this rush of waters, those who hunt in the vicinity cannot be induced to visit the falls or the canyon below . . . The noise of the fall has a stunning effect and, although deadened because of its inclosed situation, can be heard for more than ten miles away, as a deep, booming sound. The cloud of mist is also visible from any eminence within a radius of twenty miles".[15]

In 1896 Low descended Moose River to James Bay and sailed in a government fishing vessel some 450 miles along the east coast of Hudson Bay to Richmond Gulf. From the Gulf he crossed the height of land and paddled down the Stillwater, Larch and Koksoak rivers by canoe to Fort Chimo. In the next season Low and his party surveyed the north coast of Labrador along Ungava Bay and the south side of Hudson Strait, exploring and mapping by boat. In the two following seasons he examined in similar manner the east coast of Hudson Bay along its entire length.

In 1903 Low led a federal government expedition into northern waters in command of the 465-ton *Neptune*, carrying a crew of 43. On this 15-month-long mission Low, in the name of Canada, took formal possession of Southampton, Ellesmere and adjoining islands in the Arctic Archipelago. In his book "Cruise of the Neptune" Low provides a memorable account of this 10,000-mile voyage.* One of the important objectives of the expedition was to conduct topographic surveys of areas covered by it. C. F. King of the Geological Survey was in charge of this mapping activity.

Pioneer geologists in Canada were never provided in advance with accurately contoured topographic maps so essential to the effective presentation of the geological information they gathered. Accordingly, in the early stages of national development both the mapping process and the assembling of data had to be carried on concurrently by geologists in the field. This burdensome condition obtained for some years after the turn of the century because the staff of draughtsmen employed by the Survey was limited in numbers and thus unable to cope with rapidly expanding requirements. The opening up of the country at an unprecedented pace had stimulated a lively demand for accurate topographic maps. Pressures continued to mount steadily for improved map-making services.

Frequently the obligation of the working geologist to function in a dual capacity interfered with the accurate definition of geological boundaries. All too often this state of affairs prevented him from recognizing in the field those aspects of his information that needed amplification. Geologists in those formative times seldom got back to the same field to revise their maps before publication. Various schemes were improvised to deal with this unsatisfactory situation. Copies were made of all serviceable maps and plans in Crown Lands Offices of Upper and Lower Canada, and geological surveys were often carried out by means of important corrections made on these documents.[16] Later, when explorations and surveys were made for railway-building purposes, boundary lines and timber limits, tracings of resulting maps and plans were obtained by the Geological Survey. Copies of a number of plans of government surveys of the Canadian Pacific Railway were preserved intact in this way when the record office in Ottawa was destroyed by fire in 1872.

During the opening decade of the 20th century it became clearly evident that the most logical solution of the problem would be the appointment of a permanent staff of trained topographers, directed by a man well-versed in the arts of mapping. Such an arrangement, it was reasoned, would make possible the assignment of a topographer to assist the geologist in the field by providing him with a map of the area even before the examination of it began.[17]

Consequences of a tragedy that occurred in the Canadian Rockies early in the new century spurred mappers of the Geological Survey of Canada into special activity and placed their work in the spotlight of public attention. Early on a spring morning in 1903 a disaster of

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*Government Printing Bureau, Ottawa, 1906.

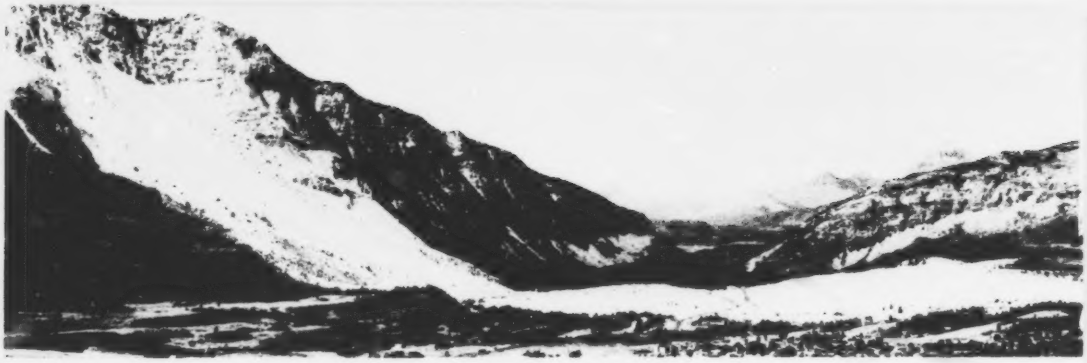
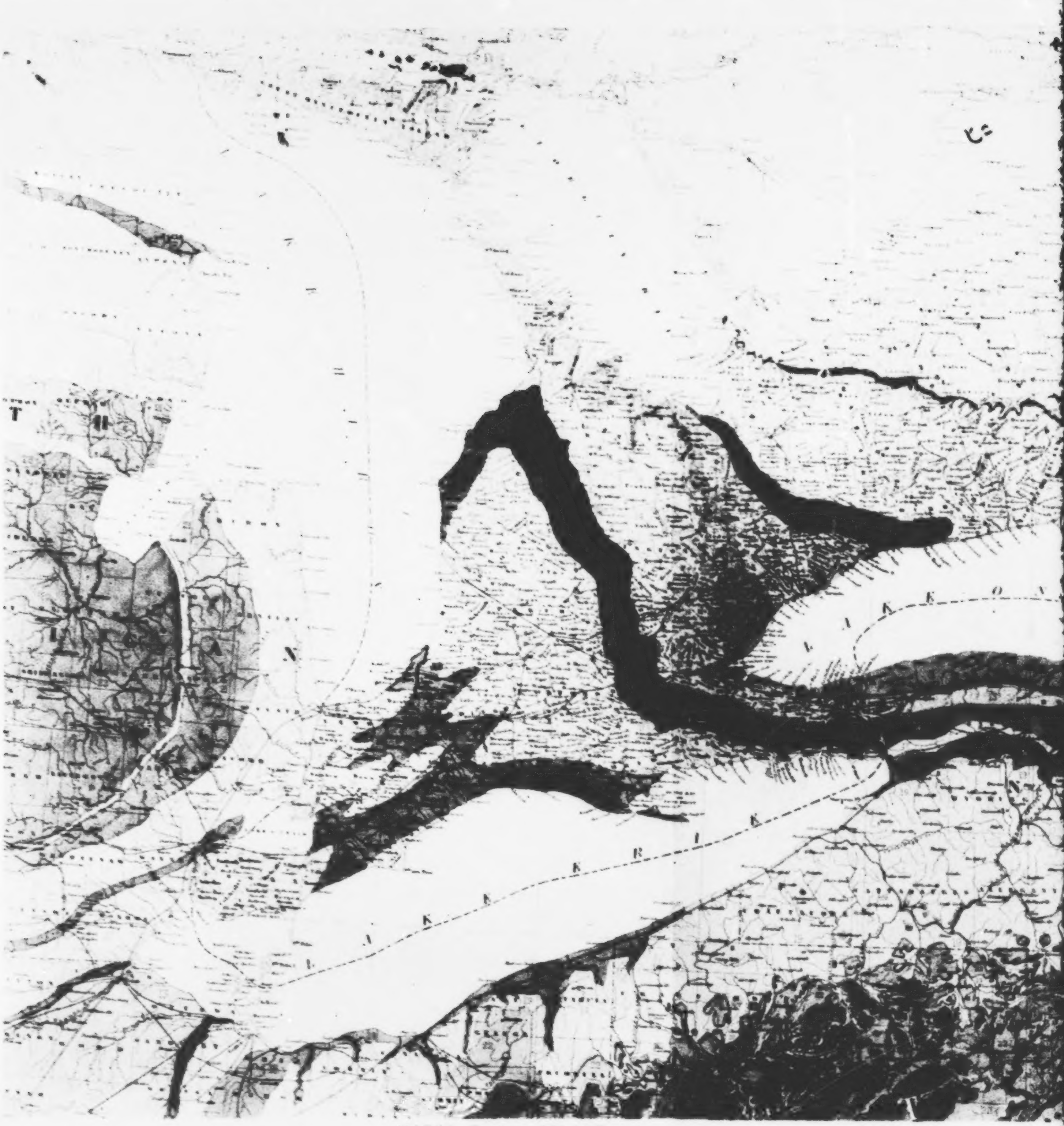


FIGURE 127. Photo of the Frank slide.

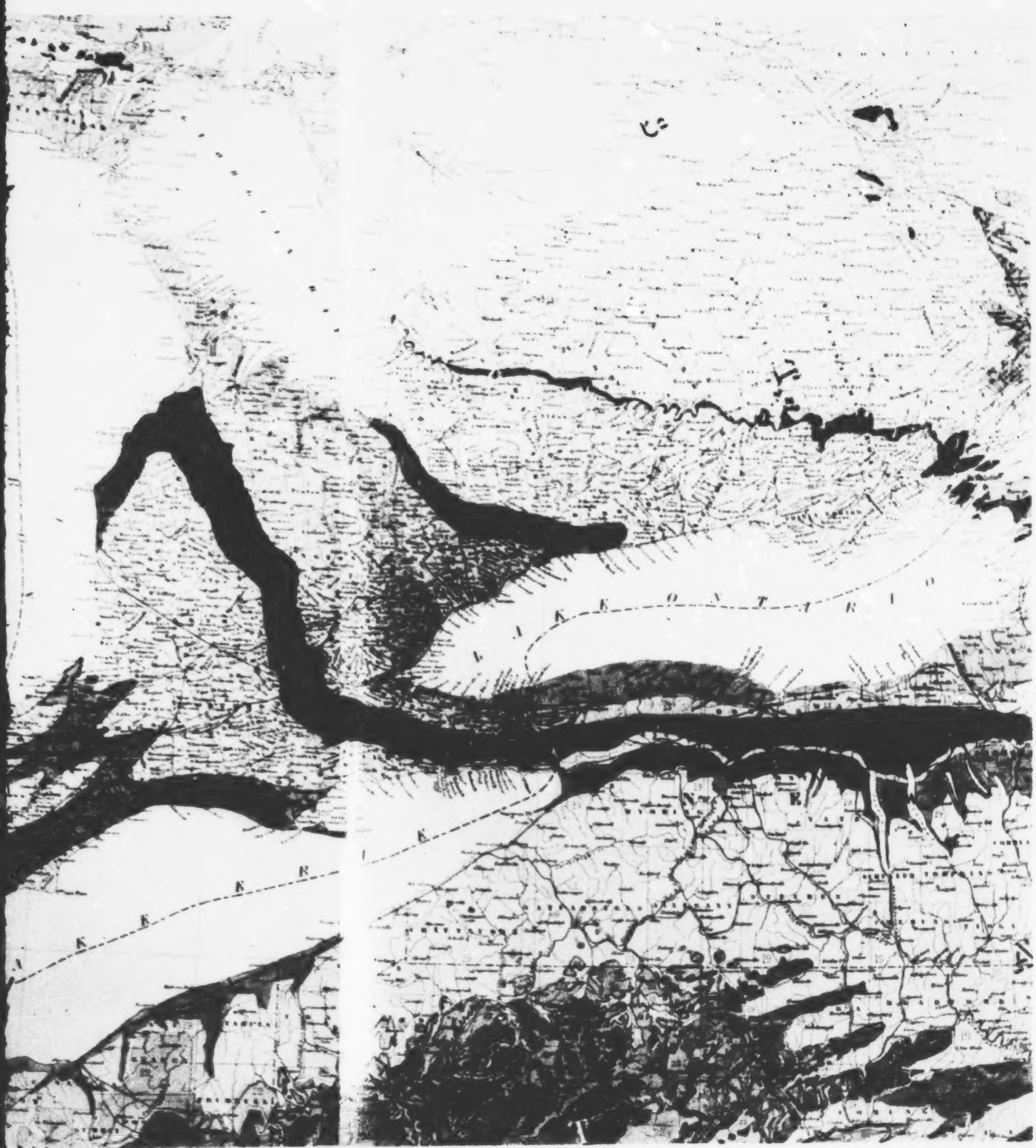
awesome magnitude struck the Alberta town of Frank, located in the Crowsnest Pass, nestling at the base of Turtle Mountain. The town had come into being two years previously when the Canadian American Coal and Coke Company had commenced mining operations. By 1903 more than 1,000 tons of high grade steam coal were being produced daily by this community, named after A. L. Frank, the company president. At the end of the early morning shift on April 29 a wedge of limestone rock, estimated at 70,000,000 tons, broke away from the mountain top and crashed down, without warning, on the sleeping community and mine workings. Within 100 seconds the town was almost completely buried, the entire coal mine workings wiped out, the course of the Old Man River altered and the Canadian Pacific Railway line through the pass was covered to a great depth. A dense pall of dust hung over the affected area for many hours after the avalanche. There has never been any reliable count of the lives lost in this calamity but officially the total was set at 66. In June, 1903, R. W. Brock and R. G. McConnell of the Geological Survey staff were appointed a commission by Interior Minister Sifton to make a report to him about the Frank Slide and, in part, their verdict was that the slide had been due "not to a single cause but to a combination of causes, among which the opening of a large chamber in the mine, situated under the base of the mountain, may have been a contributing cause".[18]

Following the catastrophe the Survey kept Turtle Mountain under close inspection. In October, 1910, Brock and Boyd of the staff visited the site of the slide in company with Provincial Mines Inspector Stirling and three representatives of the coal mining company. As a result of their findings it was recommended that the coal seams at the base of the peak be not disturbed because of the unstable condition of the northwest peak and shoulder of Turtle Mountain. In the field season of 1910 Boyd and his assistants made a topographic map of the area and this map, in manuscript form, was placed at the disposal of a government commission of three men who investigated post-slide conditions in 1911. In addition to the detailed map he supplied, Boyd contributed a useful miniature model of the mountain, using the map as a guide.[19] The report of this commission confirmed opinions previously expressed by officers of the Geological Survey of Canada on the dangers inherent in any continuation of coal mining in the immediate vicinity of Turtle Mountain.

Reginald Walter Brock (1874-1935) early recognized the need for specialization within the Survey organization and decided to do something about it. In 1908, when he succeeded Low as Director, Brock concentrated on the task of improving the over-all efficiency of the Survey. He fathered the formation of the Topographical Division as an agency staffed by men capable of preparing all topographic maps required for the effective presentation of geological data. In Walter Halcro Boyd (1878-1960) Brock found the man he wanted to be chief of the new division. The 22-year-old Boyd, an outstanding athlete and gifted map maker, had joined the Geological Survey as a topographer in the early summer of 1900. The son of Sir John and Lady Boyd of Toronto, the newcomer to Ottawa was a graduate of Upper Canada College and the University of Toronto.

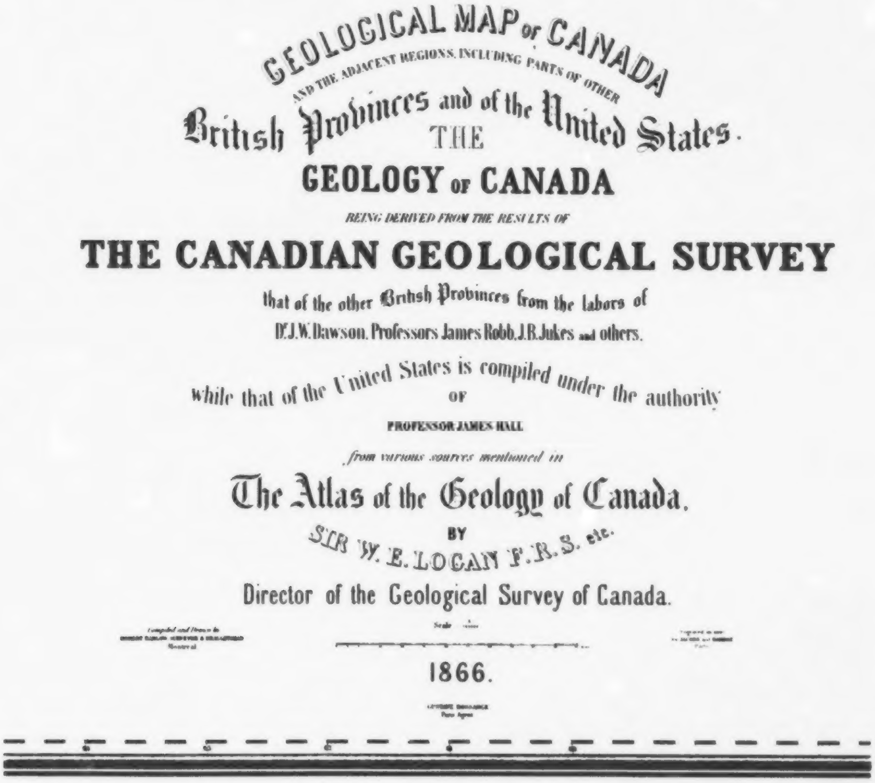

LAKE ONTARIO
LAKE ERIE

MAP 16. Portion of Sir William Logan's geological map of Canada, 1866.


LAKE ONTARIO
LAKE ERIE

MAP 16. Portion of Sir William Logan's geological map of Canada, 1866.

Brock and Boyd made an ideal team in organizing and promoting the development of a new topographical division. Yet something more was required to advance this staff-building program. What was needed was the contribution that could be made by a geological surveyor of long experience in the field who possessed also administrative abilities of a high order.[20] The United States Geological Survey was approached on this problem and as a result, and at his own request, Major Robert Hollister Chapman (1868-1920) of that organization was loaned to help train a corps of qualified Canadian topographers serving the Geological Survey of Canada. At the time of this transaction Chapman had upwards of thirty years of service with the American government agency, much of it in the field. He had explored and mapped wilderness areas in the southwestern states, including famous Death Valley. His topographical skill had impressed Canadian authorities and the Survey readily agreed to employ Chapman for three successive seasons, commencing in 1909. During his stay in Canada he introduced American mapping techniques and instructed newcomers to the Topographical Division in this type of field work. It was not an easy matter in those days to assemble a suitable group of trainees. Brock, in fact, complained officially about the difficulty "in securing the right type of qualified men" for the new division.[21]



GEOLOGICAL MAP of CANADA
and the adjacent regions including parts of other
British Provinces and of the United States.
THE
GEOLOGY of CANADA
being derived from the results of
THE CANADIAN GEOLOGICAL SURVEY
that of the other British Provinces from the labors of
Dr. J.W. Dawson, Professors James Robb, J.B. Jukes and others.
while that of the United States is compiled under the authority
of
PROFESSOR JAMES HALL
from various sources mentioned in
The Atlas of the Geology of Canada.
BY
SIR W. E. LOGAN F.R.S. etc.
Director of the Geological Survey of Canada.
1866.

Legend from Logan's 1866 map (see facing page).

Despite recruitment problems there was one appointment to staff at this time that Brock never had any reason to regret. Kenneth Gordon Chipman (1884-), born in Berwick, Nova Scotia, the son of a merchant, went to Boston to continue his education there. Dr. R. A. Daly, a professor at the Massachusetts Institute of Technology had served for a time with the Geological Survey of Canada and had recommended this promising young student to Brock's attention. Following his graduation from the Institute in 1908 Chipman received word from Brock to report to him in Ottawa. Chipman, on arrival, was promptly employed on summer work with the Survey at the monthly rate of $45.00. His preliminary work was so satisfactory that he was appointed to the permanent staff of the Survey in September, 1908, at the annual salary rate of $1,300.00. Because of a tangle in red tape formalities Chipman had to wait, however, until the following March for his first pay cheque! He was the first to join the staff of the Topographical Division after Boyd was made its chief. Chipman's long, distinguished career in federal government topographic work extended over forty years, more than a quarter-century of that period with the Geological Survey of Canada.

In the summer of 1909 Chapman was placed in charge of several Geological Survey parties engaged in topographic mapping of southern parts of Vancouver Island, with Chipman as his senior assistant. The Canadians were introduced to what were considered by their American instructor to be advantages of military discipline and procedure. Camp tents, in the tidiest possible arrangement, were dominated by a tall, central flagpole from which flew the Union Jack and the red and white pennant of the Survey. There is little hard evidence, however, to support the yarns of some veterans of these Island surveys who claim that topographers were marched in formation from camp to their field stations and back. But semi-military garb was issued to each man, consisting of khaki jacket and trousers. The jackets could be fastened snugly at the neck by special bronze buttons of Survey design. A light Stetson hat completed the impressive ensemble. Chapman's plan in recommending the adoption of this uniform was not, apparently, that it should be worn in the field but rather on visits to nearby communities. Work clothes inevitably got soiled, wrinkled and out of shape. In Chapman's view it was important that men under his authority possess a smartly-turned-out appearance in their contacts with the general public. Most of the quasi-military trimmings introduced by Chapman failed, however, to capture the imagination or approval of Canadian surveyors and were promptly discarded after the Major's departure to the United States.

FIGURE 128
K. G. Chipman.

The first season's work on Vancouver Island extended from early June to November. All of the Saanich Peninsula and a part of Saltspring Island as well as a number of smaller adjacent islands were mapped, the total area involved being about 150 square miles. The plane table was used and it was Chipman's first important contact with this map-drawing method. But he quickly mastered the technique. Field maps were drawn on a scale of 1:48,000, with 20-foot contour intervals. Eight assistants, including T. A. McElhanney, worked on these tasks. The topographer would complete a pencil drawing in the field, leaving only the inking and lettering for the office at season's end. Meanwhile at Slocan in British Columbia, Boyd and a party were busily mapping some 276 square miles, including principal towns and mines of the district. In the Lake Simcoe district of Ontario, W. A. Johnston and party were continuing the mapping of areas first investigated by Alexander Murray in the early 1850s.

Four parties took to the field on Vancouver Island under Chapman in the second season of his direction, beginning work in May. Chiefs of party were K. G. Chipman, S. A. Wookey, B. R. MacKay and T. A. McElhanney. Although the topographers were much handicapped by forest fires and dense smoke, followed by days of heavy, continuous rains, about 1,000 square miles were mapped during 1910. Brock, by now Director of the Survey, was enthusiastic in his report on the season's accomplishments under Chapman's supervision. "A corps of carefully selected topographers", Brock reported, "is being trained and our standard maps now being made will compare favorably with those produced anywhere. No part of the Geological Survey's work is of more economic value."[22]

In 1911 the topographic work was resumed on the island with Chapman's party working on the Alberni sheet, Chipman and one assistant on the Cowichan Lake sheet. Although delays were experienced because of foggy conditions and because travel overland was made exceedingly difficult by dense underbrush and a lack of trails, the two survey parties together mapped 2,805 square miles. Scales of these maps varied from 400 feet to the inch to 4 miles to the inch, with contour intervals ranging from 10 to 500 feet.

Chapman returned to the United States after the 1911 season. In 1913 he was placed in charge of Glacier National Park, Montana, as superintendent. It was an area he had helped to map in other days. As an enthusiastic mountain climber he returned briefly to British Columbia in 1915 to scale Mount Sir Sandford, highest peak in the Selkirks. He died in New York City on January 11, 1920, at the age of 52 and his remains rest in Arlington National Cemetery. Mount Chapman in the Selkirks is a permanent monument to his distinctive, valuable contribution to Canadian geological surveying and topographical mapping at a critically important stage of development. A high peak in the Rockies of Glacier National Park also bears the name of this eminent geologist.

In the summer of 1912 Chipman, while engaged in a photo-topographical survey of Windermere Valley in British Columbia, had a narrow escape from death. One day, after a climb of about 1,000 feet he was suddenly confronted by an angry grizzly bear mother with her two cubs. Chipman tried to leave the spot with some celerity but the bear caught him and tore one knee severely with fang and claw. She was about to sink her teeth into his foot when she hesitated, turned and then decided to amble off with her cubs. The incident, though painful, failed to diminish Chipman's enthusiasm for survey work in the great outdoors. His knee mended without complications and he was soon back in the field.

In 1913 the Geological Survey and the Department of Naval Affairs, Ottawa, cooperated in the formation and despatch of the Canadian Arctic Expedition in that year. The expedition was organized into two parties, all personnel sailing aboard three vessels, namely the flagship ***Karluk***, the ***Alaska*** and the 30-ton schooner *Mary Sachs*, with Herschel Island as their destination. The northern party, under Vilhjalmar Stefansson, expected to probe for new land

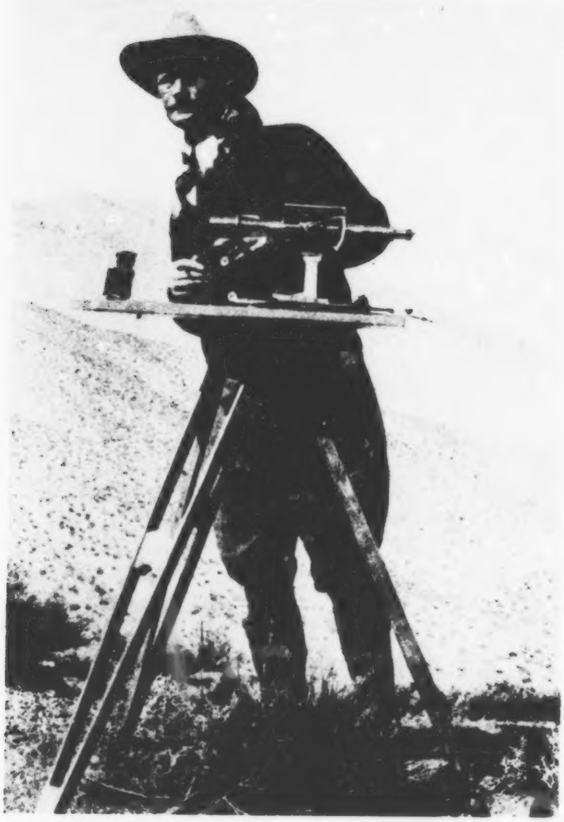
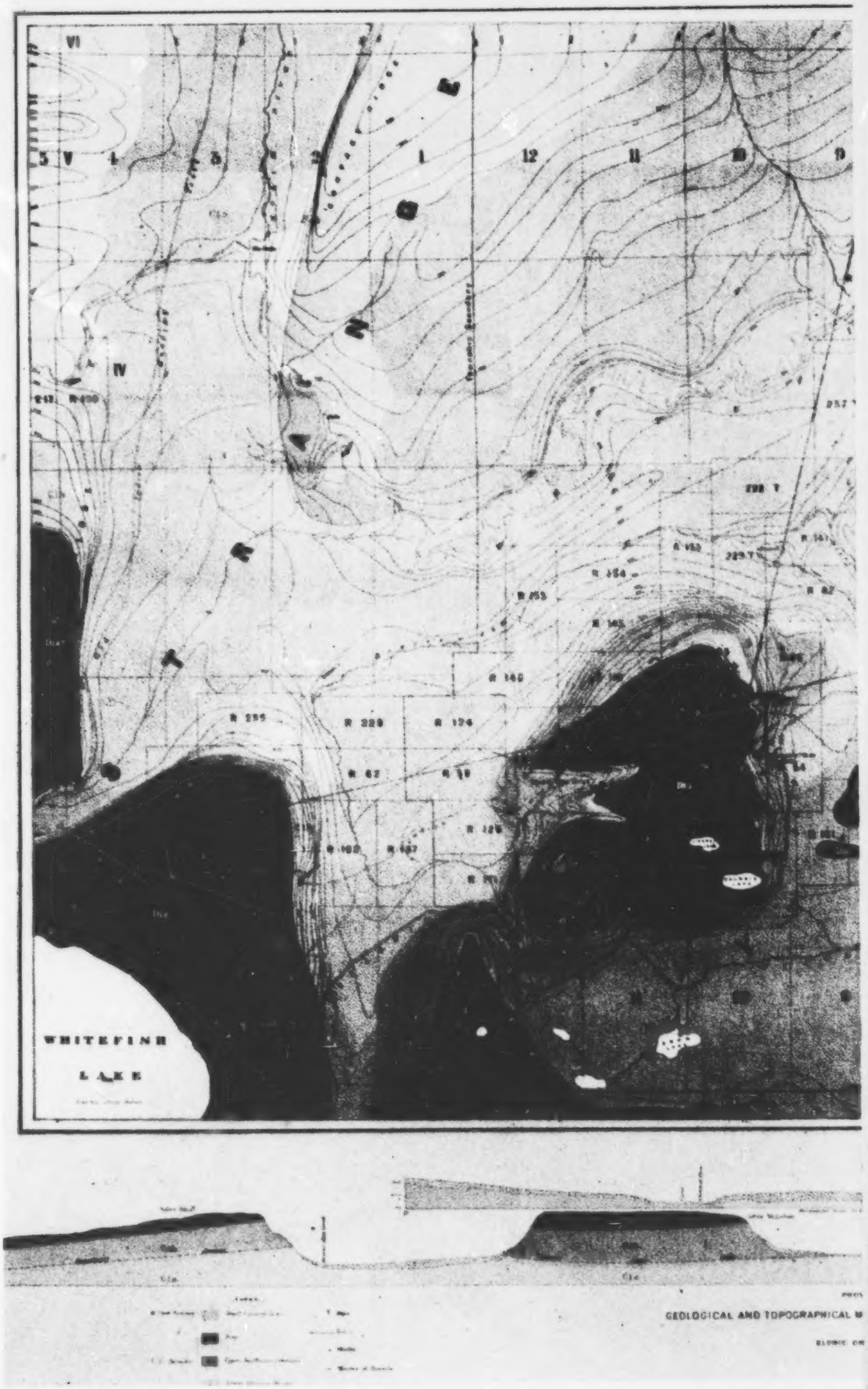


FIGURE 129
R. H. Chapman.

north of the Beaufort Sea. The southern party, composed in the main of scientists under Rudolph Martin Anderson of the Geological Survey, was to map along the Arctic coast of Canada, survey channels among islands at the mouth of the Mackenzie River in the interests of navigation, make a geological survey of as much as possible of the Arctic coast of this country, and to gather information on the flora and fauna of the region. Chipman was named second in command, or "next senior officer", of the southern party. The *Karluk* was to sail northward along the line of the 141st meridian until blocked by ice or by land. This latter project had to be abandoned, however, when the *Karluk* was firmly caught in ice and was lost to the expedition. The little fleet left Victoria with high hopes on June 17, 1913, and sailed out of Nome, Alaska, at the end of July. The vessels soon became separated in stormy weather but Point Barrow, Alaska, was rounded by the *Karluk* on September 12.

Three "geographers" were attached to the expedition, all of them from the Geological Survey staff, namely Chipman, George S. Malloch and John R. Cox, the latter being listed as an "assistant geographer". Malloch was also assigned to the project as a geologist. Skilled in his profession he had mapped in the vicinity of Portland Canal and in many other parts of Canada. Malloch was a casualty of the expedition, dying from nephritis on Wrangel Island.[23] In addition to the geographers, J. J. O'Neill was in the party as a geologist. Diamond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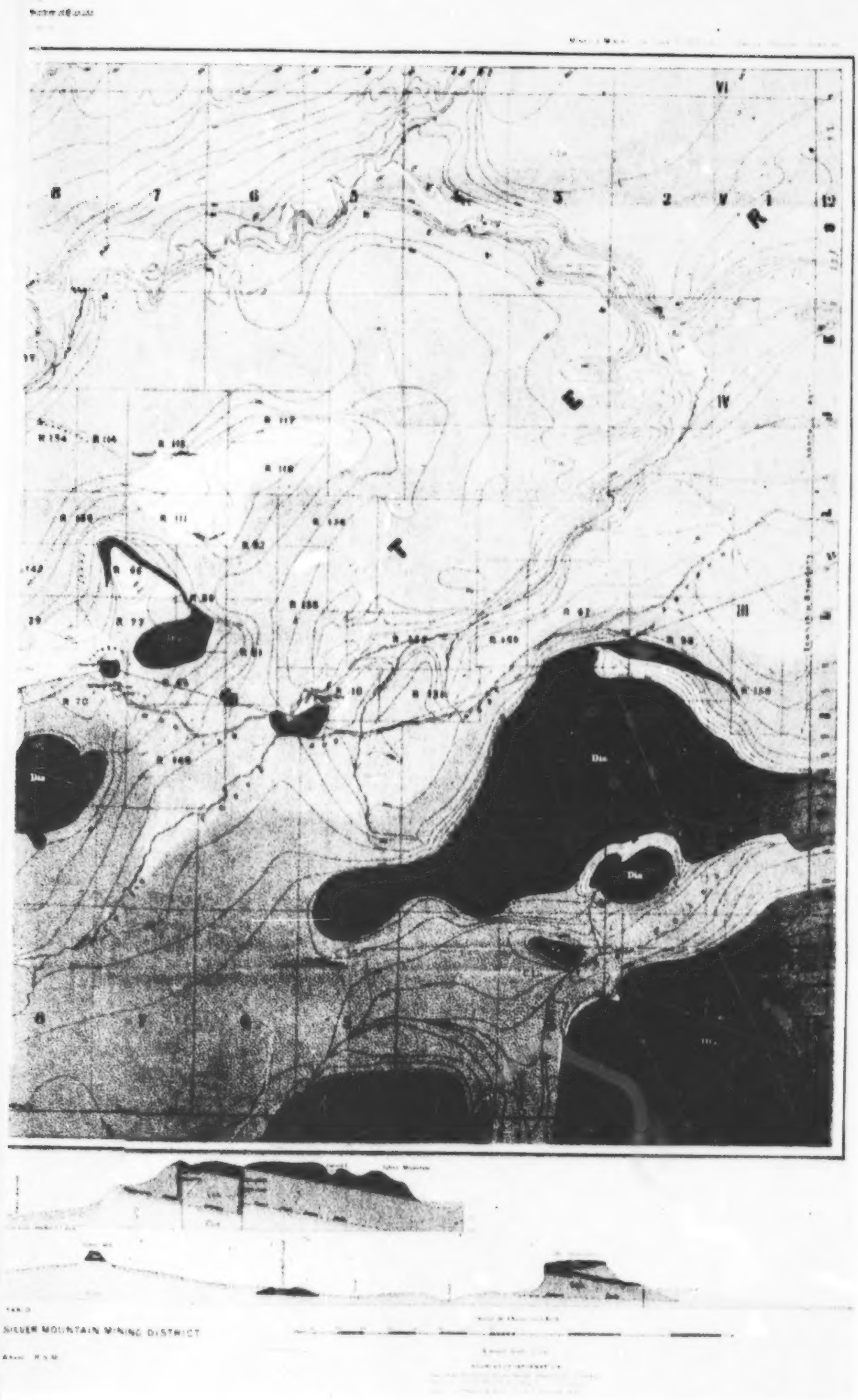
GEOLOGICAL AND TOPOGRAPHICAL M

MAP 17. Portion of the Silver Mountain sheet by E. D. In



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SILVER MOUNTAIN MINING DISTRICT

1887. This is the first contoured Canadian geological map.

Jenness and Henri Beauchat served as ethnologists, the latter also meeting his death in the Arctic on this mission. F. Johansen was assigned as a marine biologist.

The scientific work of the southern party was kept strictly under the jurisdiction of the Geological Survey. The full implications of this arrangement were not foreseen by all in the northern party, including its leader. This lack of complete understanding, along with Stefansson's determination to test his long-held theory that Arctic explorers could live off the country, even on ice floes, led to ill-feeling between Stefansson and Anderson, an attitude of hostility which continued to manifest itself long after the termination of the expedition.

In the three summer seasons, 1914 to 1916, Chipman and Cox carried out a topographic survey from the 141st meridian along the Arctic coast to a point well down in Bathurst Inlet, roughly half of the coastline distance to Hudson Bay, including a number of islands in Coronation Gulf and Bathurst Inlet regions. Their maps were made on a scale of 10 miles to the inch. In the 1915 field season Cox made a survey of Rae River which runs into the Gulf from the west.

Chipman had considerable respect for the natural ability of some Eskimos and Indians to draw maps and to accurately judge and remember distances. On one occasion, when he asked an Eskimo boy what Herschel Island was like, the youngster drew with a pencil a very close approximation of the island's outline, complete with its little harbor. Another time Chipman inquired of an Eskimo woman the distance by foot along the south shore of Great Bear Lake from the mouth of the Great Bear River to the eastern extremity of the lake. After some thought she replied, "29 sleeps". An Indian, when asked by Chipman to give him an estimate of a certain distance on the Mackenzie River, told him, after reflection, "19 bends", information that later turned out to be quite accurate.

On April 12, 1916, Chipman left Bernard Harbour with Eskimo assistants and a Mounted Police corporal as aide and finished surveying the south shore of Coronation Gulf eastward from the mouth of Rae River to Cape Barrow, N.W.T. (not to be confused with Point Barrow, Alaska). The entire survey was completed by May 20. Chipman left the ship's party at the mouth of the Coppermine River on June 1 in the belief that he would reach Ottawa earlier by travelling overland than those sailing on the *Alaska* and thus convey reassuring news to "outside" about the ship, its crew and passengers, in the event that, for any reason, their return cruise met with delays. Accompanied by a trader, D'Arcy Arden, Chipman trekked across country to the Mackenzie River by way of Great Bear Lake and thence southward, reaching Peace River settlement on August 18, and Ottawa at the end of the month. In doing so he had the satisfaction of contradicting by his presence in the capital previous reports in the Ottawa daily press of his demise in the silent snows of the Canadian North.

The Canadian Arctic Expedition 1913-16 added materially to Canada's knowledge of the geography, geology and natural history of the Arctic. Canada's claim to Prince Patrick Island was re-asserted. The venture also yielded results of economic significance, including information on the area of copper-bearing rocks near Coronation Gulf. In later years Chipman's well-lined, weathered face would break into a disparaging smile over any attempts to compliment him on his notable cartographic accomplishments. But this modest, durable and gifted Nova Scotian made an outstanding contribution to the accurate mapping of many parts of Canada, including much of its Arctic mainland coastline.

Following the resignation of James White as Geographer and Chief Draughtsman in 1899, the Geological Survey official in Ottawa responsible for the processing and printing of maps produced by topographers of the Survey in the field was Clovis-Omer Senécal (1863-1939). At the time Senécal succeeded White the maps, plans and charts in the possession of the Geological Survey totalled about 20,000 and constituted one of the largest and most

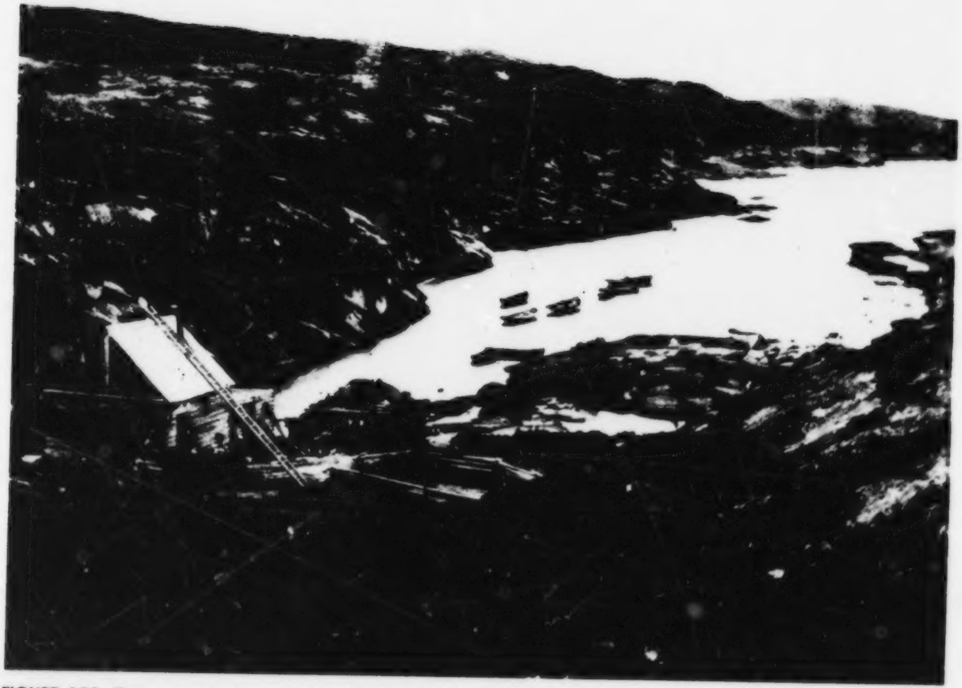


FIGURE 130. These rare photographs by James Richardson, G.S.C., in the earliest years of the camera's development possess remarkably high quality. Taken during a field survey on the Labrador coast, 1860.

valuable collections of its kind in Canada. Senécal, who echoed the complaint of his predecessor about "the congestion of mapping work" drew attention to the need of "one or two additional map compilers to catch up with the work."[24]

Two categories of early maps were issued under Senécal's supervision after the new division came into operation. First, there were preliminary maps on scales ranging from 8 to 25 miles to the inch. These maps were the outcome of reconnaissance and exploratory surveys in northern Canada. Second, there were detailed maps of standard size, drawn to scales of 1, 4 and 8 miles to the inch. Maps varied from rough, illustrative diagrams to highly accurate topographic sheets. These cartographical products were classified, in turn, as topographic, geographical, route maps, plans and diagrams. As to accuracy these productions were classed as standard, graded or inferior. Contoured topographic maps depicted relief in addition to water resources and cultural features. Geographical maps were not contoured. Route maps showed lines of early exploration. The cartography labelled as 'inferior' consisted of sketches drawn without the advantage of survey controls, although these drawings did provide a fairly general idea of the geography and geology of areas thus portrayed.

Senécal developed into an authority in Ottawa on the use of color in the printing of geological maps. The lithographic process of color printing had been in constant use since 1899 for reproduction of maps of the Geological Survey of Canada.[25] In all, 26 color distinctions were employed as it was found that this variety of tints would meet all ordinary requirements for effective printing of geological maps.

Senécal's career in the public service of Canada covered more than forty years. His appointment to the permanent staff as an Assistant Draughtsman in the Geological Survey of Canada was made in January, 1895, but he had then been in the service as a temporary for a number of years previously. Senécal retired in August, 1931, not long after his treatise on a projection suitable for maps of Canada was published by the King's Printer.[26]

In 1914 Brock, who had become Deputy Minister of the Department of Mines early in that year, was succeeded in that position by R. G. McConnell before the year was out. Brock resigned to become Dean of the Faculty of Applied Science at the University of British Columbia. Subsequently he enlisted in the Canadian Army and had a distinguished career as an officer in the forces during the First World War. His successor as Director of the Geological Survey was William McInnes (1858-1925). McInnes was a New Brunswicker by birth and upbringing. For a number of years he carried out geological investigations in his native province, first as an assistant and then as an associate of Dr. L. W. Bailey of the staff of the University of New Brunswick and sometime member of the Geological Survey of Canada. McInnes held the directorship of the Survey for six years, serving under two deputy ministers, namely, R. G. McConnell and then, briefly, under Charles Camsell.

One telling indication of the rate of expansion of the Survey, in the decades immediately following the Logan-Selwyn period, is to be found in a comparison of annual budgets of the organization. For the year ended March 31, 1895, the total sum voted by Parliament to the Survey for all its purposes was $129,000, of which $48,000 was designed for salaries. For the fiscal year ended March 31, 1917, the corresponding totals were $571,000 and $195,000.

The Geological Survey of this country won much well-earned praise and respect for its many worthwhile achievements during the half-century of its progress after Confederation was established. On many occasions members of its staff were the first to survey and to record for posterity natural and geographic features. An exhaustive listing of all early geologists active in Canada cannot, of course, be provided here but the names of Elfric Drew Ingall, Donaldson Bogart Dowling (1858-1925) and W. McQuat ought to be added to those already mentioned. The cartography of the field and office staffs of the organization was most commendable and in an era of limited revenues of government the costs of producing these maps, including original topographic surveying as well as the draughting and compiling up to the finished engraving, were extremely small compared with the immeasureable utility and value of such documents to the nation and to the world. The combined efforts of geologists and topographers had served to open up, to an impressive extent, important parts of half a continent to mining development and to settlement. Yet nothing in the pioneer years of the Geological Survey was nearly as remarkable as the men who created and expanded it and who helped to make its name well and favorably known not only throughout Canada but in many other countries as well.

19

THE ASSERTION OF CANADA'S SOVEREIGNTY IN THE ARCTIC ARCHIPELAGO

The period of discussions leading up to Confederation coincided with the completion of an era of exploration and discovery in the islands of the Arctic Ocean. With the end of the Franklin search men's minds turned from the task of finding a usable northern passage from the Atlantic to the Pacific and toward a new goal, the North Pole. With the exception of Capt. Otto N. Sverdrup's Norwegian expedition, 1898 to 1902, the known islands of the Arctic Archipelago had been discovered by British explorers. After Confederation had been successfully launched all of the territories of that vast region, over which Great Britain exercised sovereignty, except Newfoundland and its dependencies, were formally transferred to Canada.[1]

For the first time the act of transfer awakened in Canadians generally an interest in the polar north as an area of prospective importance to them and to the future of their country. This transformation in attitude did not come about suddenly but developed only gradually. A quarter-century elapsed before this growing Canadian interest was translated into earnest exploratory activity. But once a program of probing the North was adopted, it was promoted with zeal, persistence and courage during the first two decades of the twentieth century.

During the immediate post-Confederation period British expeditions into the Arctic diminished as the attention of the motherland became more and more attracted to Antarctic regions. Enterprising citizens of the United States began to fill the vacuum left by Britain in the work of penetrating farther into the polar north. Other nations began to display initiative also in the Arctic. Sverdrup (1855-1930) and Roald Amundsen (1872-1928), hardy representatives of the Scandinavian stock responsible for pre-Columbus ventures across the Atlantic out of Europe, contributed substantially to man's growing knowledge of that remote part of the world. In 1898, for example, the winter bases of Peary and Sverdrup were less than ten miles apart in a direct line. In 1903 to 1906 Amundsen commanded the *Gjoa* on the first voyage to be made from the Atlantic to the Pacific by way of the Northwest Passage.

Amundsen, the Norwegian, in reaching Nome in August, 1906, had realized the dreams of many mariners, striving over the span of at least three centuries, to accomplish that formidable crossing. Intrepid explorers of the British Navy had left tokens of their gallant ventures in many harbors and bays. Today, in the Far North, cairns, station relics and other memorials of their heroism and hardships, testify in silent eloquence to the sacrifices they made willingly in the cause of safer and wider navigation in regions barely reached by the sun.

Canadian expeditions to the Arctic, with which this chapter is mainly concerned, began late in the nineteenth century. During the first two decades of the present century these probes, carried out under the authority and with the financial aid of the federal government, assumed ambitious proportions. The later investigations resulted in a fair amount of coastal, geological and hydrographic surveying as well as in some mapping. But their principal function, viewed in the light of after events, was in "showing the flag", performing overt acts of annexation by Canada of lands ceded in the Arctic to this country by Great Britain.

Canadian government expeditions into Hudson Bay were despatched in three successive seasons, commencing in 1884. All three ventures, which concentrated upon gathering scientific information, were under the command of Lieut. Andrew Robertson Gordon, R.N. Aboard the *Neptune* on the first voyage of this series were Dr. Robert Bell as medical officer and geologist and W. W. Fox, photographer, who made free-hand sketches of the coastal profile at a number of points. At Port Burwell in Hudson Strait the harbor and a part of the adjacent coast was surveyed by the Dominion land surveyor, W. A. Ashe, appointed as one of the observers on the expedition. He also surveyed the harbor at Ashe Inlet, on Big Island off the south coast of Baffin Island. Gordon reported, "At all other stations I have myself, besides making determination of position, variation and dip, made surveys of the harbors and written out the necessary sailing directions for entering the ports. I have also made a hurried survey of the harbor at Marble Island, and obtained a plan of Churchill Harbour from one of the Hudson's Bay Company's officers."[2]

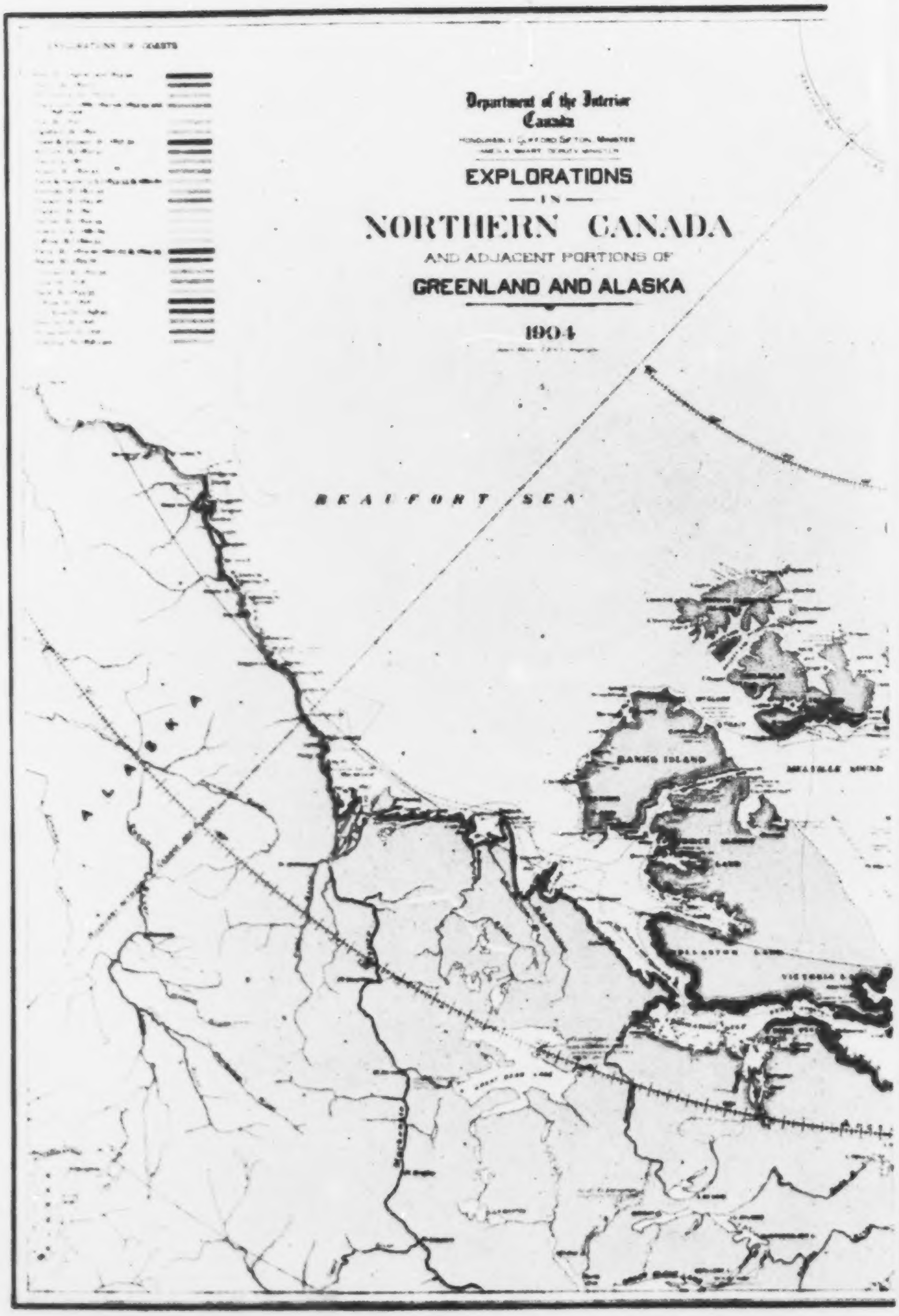
The 1884 report of the Gordon expedition was accompanied by a chart of the track of the S.S. *Neptune*.

In the following season, extending from late in May to mid-October, Gordon commanded the vessel *Alert* of 700 gross tons, a barque-rigged, screw ship, rebuilt for the 1876 Arctic voyage under Sir George Nares. Six officers and a crew of 26 manned the *Alert* on its 1885 venture under Canadian auspices. Dr. Robert Bell had James McNaughton as assistant geologist. The Dominion land surveyor J. W. Tyrrell and four other observers were also on this cruise. Although the season's work added little to hydrographic knowledge of the Hudson Bay or Strait, a track survey was made by Bell and Tyrrell from a steam launch of Outer Digges Island. In addition a running survey was made of the west side of the north group of Ottawa Islands and a series of soundings undertaken across Hudson Bay. The maximum depth found during these investigations was 94 fathoms. Some tidal observations were made of the harbor at Churchill. The 1885 report by Gordon was accompanied by a chart of the Ottawa Islands, based on an approximate survey by Lieut. Gordon; also by a track chart showing the drift of D.S.S. *Alert* in the ice during June and July of that year. This latter chart was published by authority of the Department of Marine, Ottawa.

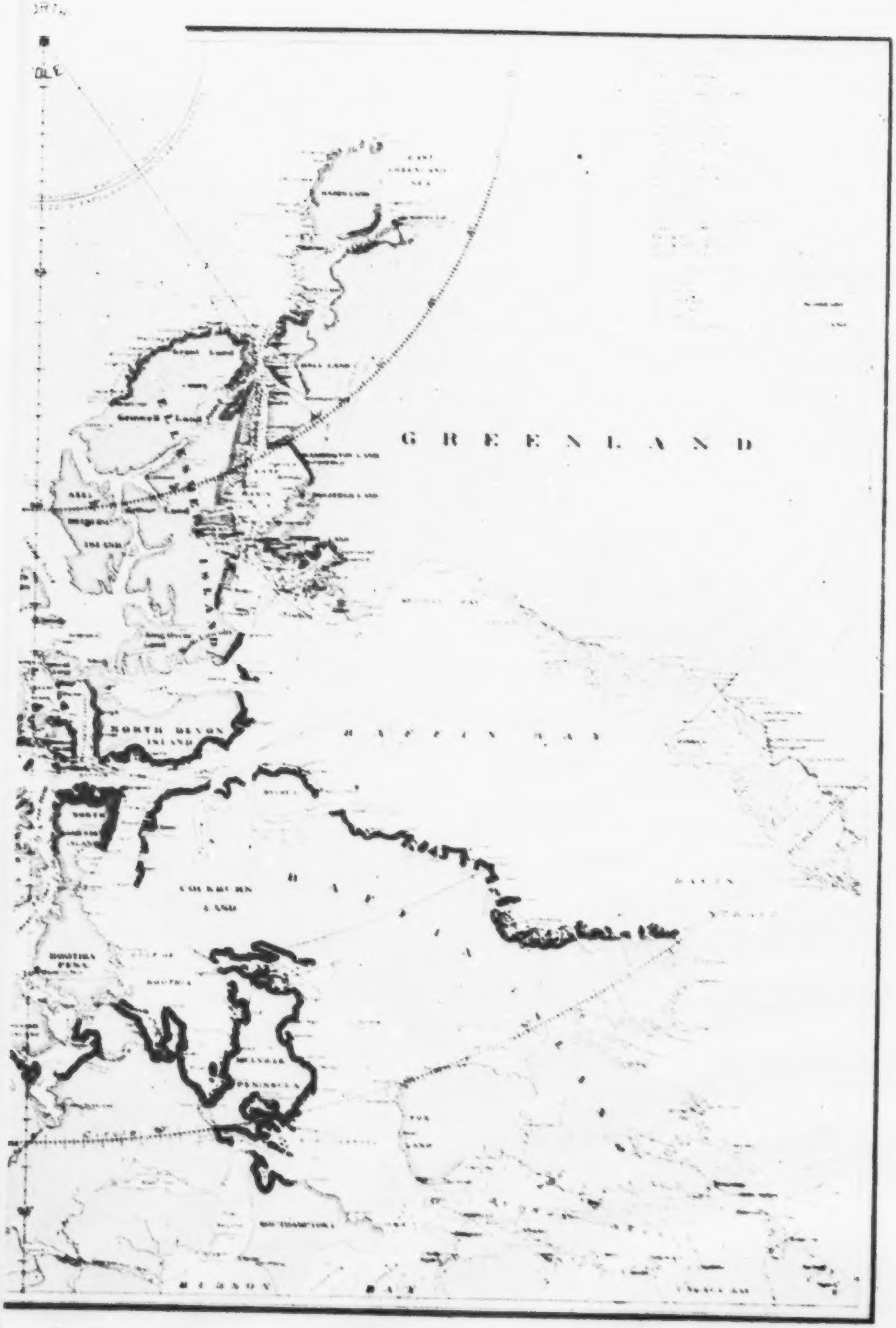
Again, in 1886, Dr. Bell and J. W. Tyrrell were among the 43 persons aboard the *Alert* which Gordon took out of Halifax on June 26, returning to that port on October 10, following a full season's work. Tyrrell, as an observer, took some survey notes at Ashe Inlet.

In the 1903-04 season A. P. Low took the *Neptune* to islands of the Arctic Archipelago, a cruise to which reference has been made in the chapter preceding this. The voyage of the *Neptune* marked the beginning of an era of Canadian Arctic expeditions, sailing under instructions to take formal possession for Canada of lands transferred to it in 1880.

In the summer of 1904-05 a new Canadian star entered the firmament of notable northern explorers. Capt. Joseph Elzéar Bernier (1852-1934), the son of Capt. Thomas Bernier, had studied Arctic navigation since the 1870s and had formed a plan for reaching the North Pole


EXPLORATIONS OF COASTS
Department of the Interior
Canada
HONOURABLE CLIFFORD SIFTON, MINISTER
JAMES A. SMART, DEPUTY MINISTER
EXPLORATIONS
IN
NORTHERN CANADA
AND ADJACENT PORTIONS OF
GREENLAND AND ALASKA
1904
BEAUFORT SEA
ALASKA
BANKS ISLAND
MELVILLE SOUND
VICTORIA

MAP 18. Explorations in Northern Canada and adjacent portio


GREENLAND
NORTH DEVON ISLAND
BAFFIN BAY
COCKBURN LAND
BOOTHIA PENN.
MELVILLE PENINSULA
HUDSON BAY

reenland and Alaska, a map by James White, published in 1904.

by way of Bering Strait. In 1904 he was given command of C.G.S. *Arctic*, a three-masted, propeller ship, 165 feet in length, of 650 gross tons. She had been the *Gauss*, a German ship designed for work in the Antarctic. In the following 21 years Capt. Bernier led 12 expeditions into the northern seas but never achieved his personal ambition of reaching the North Pole. Nevertheless he accomplished the more important objective of exploring the waters north of Canada's mainland and asserting, on the ground, Canada's sovereignty over thousands of square miles of the Arctic Archipelago.

During his first season in command of the *Arctic* Bernier was instructed to sail to Hudson Bay, in order to establish Royal Northwest Mounted Police posts and to obtain information on ice conditions and on navigation in Hudson Bay and Hudson Strait. With Major Moodie of the Mounted Police and a detail of that force aboard, the *Arctic* reached Fullerton on the west side of the bay opposite Southampton Island, and wintered there. The *Arctic* sailed for Quebec City on July 1, 1905. In his report on this voyage Bernier expressed the view that any well-engined, well-built steamer under the command of an experienced ice captain could enter the bay and strait early in July.

The first of Bernier's three most important expeditions into the north polar seas commenced at Quebec on July 15, 1906. All three voyages began and ended at Quebec and all were free of any major mishap, a considerable achievement in itself and a feat that testified eloquently to Bernier's able seamanship, observance of sensible precautions and regard for the general safety and welfare of his officers and crews.

The *Arctic*, which had demonstrated her ability to operate in heavy ice, was repaired and fitted out at Sorel under the supervision of Superintendent Desbarats of the federal government shipyard there. The expedition, consisting of 9 officers and a crew of 32, called in at Chateau Bay, Labrador, on August 3. Two days later, at sea, two icebergs were sighted heralding the approach of many months when ice would form a constant navigational menace, if not a complete prison. By the 18th the *Arctic* had entered Lancaster Sound and penetrated Navy Board Inlet. During the 1906 season Capt. Bernier formally "took possession" for Canada of Bylot, Griffith, Cornwallis, Byam Martin, Bathurst and Melville islands, constructing a cairn at each point of landing and leaving a record on the spot of his visit. At Arctic Point, Melville Island, Bernier also claimed for Canada the Prince Patrick and Eglinton islands as well as islands adjacent to them. On the return voyage to winter base at Pond Inlet on the north coast of Baffin Island, the *Arctic* found her way into Admiralty Inlet as far south as Moffet Inlet. From September 10, 1906 to July 27, 1907, the *Arctic* remained winterbound at Pond Inlet.

On the King's birthday, November 7, 1906, Bernier recounts that a Royal salute was fired. "The holiday was celebrated on board and on shore. Fifteen natives came to the ship upon our invitation to take part in the celebration . . . We also took possession of Baffin Island and caused the flag of the Dominion of Canada to be hoisted . . . I addressed the natives, telling them that they had become Canadians, that they must live in peace with one another and conform themselves to the laws of Canada. We held a rifle competition and discovered that there were some good shots aboard and that the natives are accurate with the rifle. All the Eskimos were invited to have dinner on board, and they certainly enjoyed the celebration very much."[3]

On July 27, 1907, the *Arctic* began to move again. Bernier reported that on that day "we got under way at 10 a.m. and proceeded to sea. At 2 p.m. we made ship fast to the ice, about five miles east of Albert Harbor. We took soundings and we found no bottom at 160 fathoms". Six days later an annexation ceremony was held on Cobourg Island and on that same day Bernier observed that "we took soundings and found 420 fathoms of water". On Ellesmere Island, later in August, Bernier took possession for Canada of "North Lincoln, Grinnell Land, Ellesmere Land, Arthur Land, Grant Land, King Oscar's Land, North Kent, and several islands, namely, Axel Heiberg Land, Ammund [Amund] Ringnes Land, Ellie [Ellef] Ringnes Land, King Christian Land, formerly named Finlay [sic] Land, North Cornwall, Graham Land, Buckingham Island, Table Island and all adjacent islands".[4] Bernier reported that on August 22 ". . . the sea is very smooth; we take soundings in 178 fathoms of water, mud bottom". The *Arctic* then headed southward, making a number of calls along the coast of Baffin Island. Bernier's account reads, "September 1. The fog set in and while crossing the [Hudson] Strait during the night we took the following soundings: 208, 405, 450, 425 and 420 fathoms." Soundings were also taken at Port Burwell.

FIGURE 131
Captain J. E. Bernier.

Capt. Bernier concluded his official report on the 1906-07 expedition by urging that "it is of the utmost importance that the Dominion takes possession of all northern regions as far north as the pole. Those regions abound in valuable islands which contain vast quantities of coal and other minerals".[5] Included in the official report is a map of the Geological Survey of Canada bearing the name of Dr. Robert Bell as its Acting Director. It is titled, "Map of the Northeastern Part of the Dominion of Canada To illustrate the Report on the Cruise of the D.G.S. *Arctic* to The Arctic Islands. Capt. J. E. Bernier in Command, 1906-07". The scale of this map is given as 50 statute miles to the inch. C. O. Senécal's name is on the map as Geographer and Chief Draughtsman of the Geological Survey of Canada. Sources of information for this map include Admiralty charts "corrected by later information obtained by the Peary and Sverdrup Expeditions; by surveys made on the *Neptune* in 1903-04 and by surveys made on the *Arctic* in 1906-07."

Apart from various soundings made on this Bernier probe the principal scientific information contained in the numerous appendices to his report consisted of meteorological observations, data on ice conditions and geological information with special reference to coal deposits. Capt. Bernier, in his autobiography, noted that the Canadian government, in 1930, paid Capt. Sverdrup the sum of $67,000.00 for all his maps, charts and other data resulting from his Arctic experiences, partly, so Bernier surmised, in the nature of a quit-claim notice to Norway in regard to northern territories discovered by that intrepid Norwegian explorer.[6]

On his second voyage to the polar seas Bernier left Quebec on the *Arctic* on July 28, 1908, with 6 other officers, a scientific staff of 5, and a crew of 31. The scientists included a medical officer, meteorologist, historian, geologist (J. G. McMillan) and an assistant naturalist. In late August Lancaster Sound was entered and a landing made at Erebus Bay, Devon Island, on the 24th. The ultimate destination was Winter Harbor on Melville Island.

It was during this season, in the absence of heavy, impeding ice formations, that Bernier felt he could have navigated through the entire Northwest Passage. But he had no instructions to do so. He was convinced that the route through M'Clure Strait offered the best prospects for success. Larsen and Stefansson, in later statements, disagreed with Bernier on this point, claiming that the Barrow Strait, Viscount Melville Sound and Prince of Wales Strait, passing to the south of Banks Island, rather than to the north of it, was the shortest, deepest and easiest route to navigate in order to reach the Beaufort Sea.

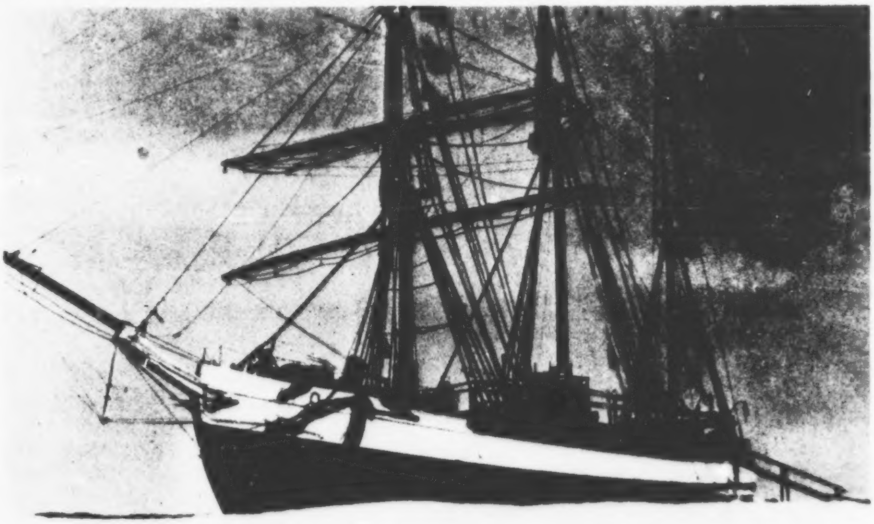


FIGURE 132. C.G.S. *Arctic* in Winter Harbor, Melville Island, 1908.

The *Arctic* remained in Winter Harbor from August 28, 1908, to August 12, 1909. Bernier reported, "Officers Morin and Green and their men deserve the highest praise for the able manner in which they carried out their orders to annex Victoria and Banks islands . . . Incidentally they found coal on Banks Island and an extinct volcano and samples of iron ore".[7]

In the season of 1909 Bernier tried unsuccessfully to penetrate Byam Channel to make soundings to discover whether the sea bottom toward the northwest was shelving or deep. The *Arctic* re-entered Barrow Strait, proceeding to Pond Inlet and, after touching at a number of points along the coast of Baffin Island, reached Quebec on October 5, 1909.

No new coastline was explored on this expedition but the official report contains many references to tides, currents and ice conditions. A number of cairns and monuments were erected. Maps and charts included as contents of the Bernier report include a geological sketch map, map of Winter Harbor, track surveys of Morin and Green on Melville, Banks and Victoria islands, beacons (in aid of navigation) in Winter Harbor and a facsimile track chart of H.M. Sledge *Success*, Barrow Strait, 1851. Also included are a chart of Jones Sound, a facsimile of Bering Strait, 1852; Depot House, Dealey Island, 1853, and showing winter quarters of Franklin, M'Clure and Kellett. A plan of Churchill Harbor by Lieut. A. R. Gordon, R.N., assisted by J. W. Tyrrell, P.L.S. with details of soundings, and a chart of York Roads, Hudson Bay, by the same two men, with soundings, are also contained in this report.

In January, 1910, W. Bell Dawson wrote a letter to Bernier that was much treasured by him in later years. The Superintendent of Tidal Surveys wrote, "The tidal observations obtained by your expedition at Melville Island are especially interesting in being from an entirely new region. Your officers deserve much credit for their perseverance in obtaining such full detail by continuous observations day and night."

In a communication dated April, 1910, addressed to Deputy Minister G. J. Desbarats, Department of Marine and Fisheries, Bernier stated, "I have the honour to submit my report of voyage of Dominion Government Steamer *Arctic* to northern waters of this continent for the purpose of patrolling waters contiguous to that part of the Dominion of Canada already annexed and for the further purpose of annexing territory of British possessions as far west as longitude 141 degrees".

The daily food ration considered sufficient to sustain a man travelling and working in the Arctic is described in the report. The ration consists of one pound of pemmican, one and a half pounds of chocolate along with fractions of a pound of biscuit, sugar, tea, potatoes, tobacco, curry and onion powder as well as pepper and salt for soup.

A lengthy geological report by J. G. McMillan was incorporated in the Bernier document. It is addressed to the Minister of Marine and Fisheries and includes a section of the topography of Devon Island. A complete record of ship positions was included in the main report as well as a number of magnetic observations taken by W. E. Jackson, the meteorologist. His instruments consisted of a dip circle by Dover, a horizontal force magnetometer by Bausch and Lomb, chronometer and hack watch, sextant and artificial horizon. These instruments were made available to the expedition by the Director of Terrestrial Magnetism, Carnegie Institute, Washington, D.C.

On July 7, 1910, the *Arctic*, again under the command of Capt. Bernier and with a total complement of 36, sailed from Quebec City on the third and last of his major voyages into the north polar seas. On this occasion Bernier was authorized to attempt a passage through the Arctic islands and Bering Sea to Vancouver or Victoria. The advisability of making this attempt to navigate the Northwest Passage was left to Bernier's judgment "after ascertaining the ice conditions on the spot". About August 18 the expedition arrived at Erebus Bay and the westward voyage was resumed almost at once. Ice conditions, however, proved most difficult. Winter Harbor was entered by the aid of stone beacon ranges established by Bernier in 1909. "All the beacons were found in position and saved the trouble of making soundings for several miles as was done in the previous entry."[8]

Soon after leaving Winter Harbor progress through M'Clure Strait was blocked by solid ice and the *Arctic* was forced to turn back. The disappointment felt by Bernier can be imagined, especially in the light of his firm conviction that the Passage could have been accomplished easily during the previous season. Bernier decided to put into Arctic Bay on Admiralty Inlet, near the eastern entrance to Lancaster Sound. By October 1 all was in readiness for the long winter months. On the basis of lessons learned from past experiences in the region, good practical use was made of the *Arctic's* winter station. Sled parties were organized and travelled extensively along Admiralty Inlet. Much of the Brodeur Peninsula was resurveyed.

Among the scientific personnel on the 1910-11 cruise of the *Arctic* were J. T. E. Lavoie, listed as "meteorologist and geologist" and Arthur English, described as "prospector and taxidermist". English reported a discovery of copper ore and promising indications of mineralization along Adams Sound. On October 10 Lavoie left the ship with an assistant and three Eskimos to map the west coast of Brodeur Peninsula. Mr. Morin, the first officer of the *Arctic*, accompanied Lavoie as far as the head of Admiralty Inlet to survey that part. Bernier claimed that Morin was the first white man ever to set foot on this coast.

On March 15, 1911, Lavoie again left the icebound ship, accompanied by two Eskimos and headed for Fury and Hecla Strait with instructions "to trace the shores of the strait, to make surveys when possible, and to observe movements of the ice". These tasks were carried out under great difficulties and completed about a month later. On this project Lavoie suffered extreme hardships, including the effects of severe burns on his face incurred in an unfortunate accident. Not until July 19, 1911, was the *Arctic* released from the grip of ice. Ten days later the vessel broke into open sea off Elwin Bay. Pond Inlet was reached on August 6. After surveys of the south shore of Eclipse Sound, south of Bylot Island, Bernier sailed north through Navy Board Inlet, thence westward along the south shore of Lancaster Sound. Once again heavy ice foiled plans to continue investigations. On September 25 the ship reached Quebec City, concluding its 10,000-mile voyage without incurring any undue amount of damage. Winter side trips by means of sleds totalled an additional 4,000 miles.

The official report of this voyage included geological reports, mostly pertaining to areas of Baffin Island. Maps attached to the report included a plan of Arctic Bay, drawn by Lavoie and marked with soundings and elevations; a plan showing the route followed by Lavoie and his party on the 1910 coast survey of Prince Regent Inlet, and a map titled "Surveys and Discoveries in the Arctic Regions with additions and changes to 1911 on the Coast of Baffin Island" by J. T. E. Lavoie, C.E.

More than a decade later Capt. Bernier made one more voyage to the north polar seas aboard the *Arctic* but this probe was considerably less impressive in its scope and results than the four previous ventures of that vessel under his able command. In addition, in its chronological aspects, this 1922 patrol of the Eastern Arctic is beyond the scope of this volume.

Vilhjalmur Stefansson (1879-1962), during the course of the large expedition (1913-1918) to which reference has been made in a previous chapter and which was sponsored by the Canadian government, travelled extensively in western portions of the Queen Elizabeth Islands, as these are now known. Stefansson added immensely to geographical knowledge of that area and, during this period of discovery, he brought into Canada's domain the important Brock, Borden and Meighen islands. Borden Island, contrary to Stefansson's supposition at the time, turned out to be not one but two islands, separated by Wilkins Strait. The northerly one retains the original name but the more southerly one has been named Mackenzie King Island. In addition, Stefansson's resurvey of King Christian Land resulted in the separate delineation of Lougheed Island.

In his busy exploration season of 1916 Stefansson completed a survey of parts of Borden Island and made a trip around most of the coastline of Meighen Island. He then crossed to Amund Ringnes Island and surveyed its west coast. In this general area of the north, Stefansson corrected a former survey showing the Findlay Group as consisting of three main islands.

In concluding this outline of Canadian surveying and mapping in the Far North we may, at this point, permit ourselves a glance into the future. As Andrew Taylor expressed it in his excellent volume, *Geographical Discovery and Exploration in the Queen Elizabeth Islands*, "the first vessel to have made the Northwest Passage from west to east, first vessel to have made the passage in both directions, and the first vessel to have made the passage in a single season—these are honours that belong to the R.C.M.P. schooner *St. Roch*". Three hundred and sixty-eight years after Martin Frobisher first attempted to enter the Arctic, seeking a northern water route to the Orient, the *St. Roch* in 1944 under its Master, Staff-Sergeant Henry A. Larsen, completed the passage in a single year from east to west in 86 days, reaching Vancouver on October 16.

In Larsen's modest yet memorable words, "We were lucky and we had the breaks. No one can predict the ice or navigation conditions in the Arctic. What we accomplished this year might be repeated the next, or it might be many years. Much would depend upon the type of vessel used, and the ice conditions of that particular year. Our voyage showed that the Northwest Passage can be traversed in a single year, but does not prove that this could be accomplished every year."[9]

ACKNOWLEDGMENTS

In a rather extensive appendage to Volume One of this history I endeavored to express, as comprehensively as I could, my deep appreciation to individuals and organizations whose advice and assistance have been of special value to me in my research and writing. But as the work on this project continues, new sources of help have developed and in order to make my acknowledgments more complete I wish to take this opportunity to add to my catalogue of thanks the Air Photo Library, Ottawa, under the direction of G. Whitcher; officials of the Indian Affairs Branch and its library staff, Ottawa, with special mention of H. T. Vergette, J. Raichman, Bernie Downie and A. R. Goulet of the Surveys and Titles Section of that Branch; the Municipal Archives of the City of Montreal and, in particular, Director Gérin-Lajoie and the Guardian of Official Maps and Plans, René Lanthier; and to the following persons; Dominion land surveyors Carl Engler, Hans Kihl, L. M. Sebert and C. C. J. Bond; Mrs. Lois Winslow-Spragge, Montreal; Malcolm M. Thomson and Miss M. Burland of the Dominion Observatory staff, Ottawa; W. Ron Young, Chief, Geographic Division, British Columbia Surveys and Mapping Branch, Victoria; Ernest C. Elliott and John Imsley, Photographic Section, Geological Survey of Canada; J. G. Côté, Research and Development, Canadian National Railways headquarters, Montreal; George O. Wood, International Boundary Commission staff, Ottawa; E. Roy Logie, formerly Chief Engineer, Central Division, Canadian National Railways, Toronto; G. Babbage and S. Kitaljevich, Legal Surveys and Aeronautical Charts Division, Ottawa; Kenneth B. Jackson, Staff Scientist, The De Havilland Aircraft of Canada Limited; W. J. Gordon Wadsworth, Director of Surveying, City of Toronto and Mrs. N. C. Carico, U.S. Geological Survey staff, Washington, D.C.

I indulge in repetition to the extent of again expressing my profound gratitude to T. E. Layng, Chief, Map Division, Public Archives of Canada; Maurice Caron for research in Quebec and Montreal archives; to Douglas Shenstone, editor; S. G. Gamble, Director, Surveys and Mapping Branch and his administrative staff for constant aid and encouragement; to A. M. Floyd, Dalton Long, Eric J. Smith, A. B. Hammond and S. B. Lerner, all of the Department of Energy, Mines and Resources, Ottawa, the latter four officials being of the staff of E. D. Baldock, Chief, Map Compilation and Reproduction Division who, himself, has been a generous source of aid and inspiration; to W. Eric Carroll and Arthur Armstrong, Lands and Surveys Branch, Ontario Government, Toronto; J. A. Haddon, Chief, Maps and Reports Division, Department of Mines of Ontario, Toronto; Miss Florence Stephens, typist; O. M. Meehan, Canadian Hydrographic Service, Ottawa; Elizabeth Walker, librarian, Surveys and Mapping Branch; and for excellent translation services, the Translation Bureau, Department of the Secretary of State, and Louis Lebel, Chief, Translation Office, Department of Energy, Mines and Resources and his staff.

I wish also to acknowledge, with thanks, the special guidance I have received from the Marine Sciences Branch publication "The History of Hydrographic Surveying in British Columbia" by R. W. Sandlilands.

I wish to make special mention also of my indebtedness to John Carroll's "A History of the Canadian Institute of Surveying and Photogrammetry" published in the April, 1957, issue of The Canadian Surveyor. I am grateful also to Mrs. N. A. Sparks, Ottawa, for information concerning her father, J.-E. Chalifour, Chief Geographer, Department of the Interior, Ottawa.

Don W. Thomson.

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MEN AND MERIDIANS

The History of Surveying
and Mapping in Canada

Volume 3
1917 to 1947

Don W. Thomson

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Available in Canada through

Authorized Bookstore Agents
and other bookstores

or by mail from

Canadian Government Publishing Centre
Supply and Services Canada
Ottawa, Canada K1A 0S9

Catalogue No. M 52-2069/3 Canada: $8.00
ISBN 0-660-00359-7 Other countries: $9.60

Price subject to change without notice

Ottawa 1969

Reprinted 1981, 1984

Prefatory Note

The contents of this third volume of MEN AND MERIDIANS pertain, in the main, to the story of surveying and mapping in Canada from the closing stages of the First World War to the conclusion and immediate aftermath of the Second World War. In Volume One Canadian activity in these two closely related fields of constructive endeavor, leading up to union in 1867, was traced in the context of world developments. The 50-year period following Confederation in this country, highlighted by a lively increase in surveying and mapping, is covered in the contents of Volume Two. This included the age in which steam, steel and rail came to British North America to a steadily increasing extent. The construction of transcontinental rail routes and of numerous branch railway lines attracted hundreds of thousands of immigrants to prairie homesteads and helped in a major way to open up the western interior to ordered settlement. This transformation resulted from the new availability of world markets for the early-maturing hard wheat of the region. The Peace River country, far to the northwest but possessing excellent agricultural possibilities, became a new frontier for eager land seekers.

Post-war prosperity in the 1920s brought in its wake a new era of oil production, hydro-electric development and expanding base-metal output as well as of automobiles, planes and motor boats. Montreal surged ahead on the commercial and industrial fronts. Toronto began to grow into an important financial centre. The success of the Panama Canal contributed greatly to the growth of Vancouver, British Columbia, into a thriving ocean port. Mining, pulp and paper, and water-power projects brought vigorous industrial activity to northern latitudes of the nation. The motor boat, tractor and plane combined to aid the development of natural resources in the Hudson Bay and Mackenzie River drainage basins.

The opening years of the 1930s were featured by swiftly changing patches of light and shadow on Canada's road to fuller nationhood. With the transfer of natural resources from federal control and management to the jurisdiction of the provinces of British Columbia, Alberta, Saskatchewan and Manitoba, new regional functions and frontiers were brought into being. The provinces also embarked upon ambitious programs of highway construction, including the paving of important traffic arteries. During the first post-war decade, in fact, development activities of the provinces doubled. During this same span of time Canada achieved Dominion status and full equality with all other nations of the British Commonwealth and began to establish its own diplomatic representation abroad. On the darker side of events the advent of the Great Depression, aggravated in the western interior by severe and prolonged drought conditions, created widespread hardship and despair and slowed Canada's economy to a stumbling pace.

All these far-reaching changes and calamities exercised their varying beneficial and baneful influences upon the fortunes of surveyors and mappers. But with the profoundly significant mineral discoveries of 1947—the opening of the rich Leduc oil field in Alberta, about 16 miles southwest of Edmonton; the startling realization of the extent of iron-ore deposits in northern Quebec and in Labrador; the uncovering of new deposits of uranium together with renewed life and vigor in base-metal mining enterprises, particularly in Central Canada—all these lifted the curtain on an era of greater promise for Canadian surveyors and mappers than the nation's history had ever known.

Issued by the
DEPARTMENT OF
ENERGY, MINES AND RESOURCES

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1

DEVILLE IN THE TWENTIETH CENTURY

"*I have done the state some service . . .*"
—*Othello,* Act 5, Sc. 2.

As the 20th century dawned the profession of land surveying in Canada had reached a standing generally considered to be equal to that of any similar body in the world. Much of the credit for this notable achievement rested with Edouard Gaston Daniel Deville (1849-1924). Following the commissioning of Deville as a Provincial land surveyor (Quebec) in 1877, and as a Dominion land surveyor and Dominion topographical surveyor in the following year, this exceptionally gifted former officer of the French Navy rose rapidly to become Surveyor General of Canada in 1885. For the greater part of the four following decades Deville exercised an unparalleled and beneficial influence upon the entire range of land surveying activities in this country and, in the later years of his career, on initial developments in the realm of Canadian air photographic surveys. Possessed of a remarkably inventive mind, linked with marked prowess in mathematics and a genius for administration, Deville was stamped from the beginning of his residence in Canada as a brilliant leader in his chosen field of endeavor. These special qualities, combined with unflagging industry, enabled him to bring world renown to the organization he directed for almost 40 years.

Testing of Survey Instruments

Deville, whose passion for accuracy was legendary, insisted that as the function of a land surveyor is to measure land, the first requisite of his occupation ought to be a correct, reliable measure. In the earlier days of post-Confederation surveying every surveyor, upon receiving his Dominion land surveyor commission, was supplied by the secretary of the Board of Examiners with a pine yardstick by which he was required to verify his chains periodically. One of Deville's first official acts as Surveyor General was to recommend the substitution of an adequate, properly tested standard of length to replace the rather rudimentary wooden verifier. In later times, and in support of his early action Deville pointed out that "if lengths had been correctly measured the land survey of the Dominion would have been the most perfect and remarkable in the world".[1]

The reform advocated by the Surveyor General was not adopted overnight. In fact, 28 years passed before his ambition in this respect was realized. In 1885 the Board of Examiners recommended, on his urging, that a 66-foot steel band should be substituted for the three-foot wooden rod and that such standards should be issued to surveyors after testing and stamping procedures by the Department of Inland Revenue, Ottawa. W. F. King, as a Board member, tried to persuade that department to provide a comparator suitable for testing line measures. The comparator that was set up some six years later proved unsatisfactory. Plans for its construction were drawn up by Deville but the workmanship based on the plans was defective. Nevertheless the comparator was in use for some years and 135 measures in all were tested by it and released for use by land surveyors. Experimental tests on sample 100-metre tape were illuminating. Five separate examinations were made, some in Canada and some in the United States, under identical conditions of temperature and tension. These tests revealed variations in tape length of more than two inches, equivalent to about three feet per mile, whereas the permissible discrepancy should not have exceeded two-tenths of an inch per mile.

Finally, after persistent representations to the government, a rough wooden shed was erected on Cliff Street, near the present Supreme Court Building in Ottawa, to accommodate a new comparator. Deville and King, who greatly respected each other's abilities, sometimes allowed their personal relationship to become quite cool. One clear indication of the existence of such a period of chilled attitudes was the decision of King to build a structure on the Dominion Observatory site for the purpose of testing steel tapes of the Geodetic Survey of Canada while Deville was directing the construction of the Cliff Street laboratory for testing the tapes of Dominion land surveyors. King made an interesting reference in an official report to the latter structure, stating that "the Cliff Street house had been the reference point of all longitudes observed up to 1905. As the reference point will now be the Observatory this longitude connection [between the Cliff Street house and the Observatory] was a necessity to correlate future longitudes with the past. It seemed advisable further that an independent connection between the two points should be made by a survey. As the two stations are not intervisible the survey had to be carried out by a triangulation extending to the hills north of the Ottawa River so as to secure points from which both stations could be seen".[2] From the beginning there could have been a single organization and structure for the advancement of these comparator projects. Long after Deville's death in 1924 the two functions were, in fact, merged.

In 1902 thieves broke into the Cliff Street building, stole steel tapes and parts of the comparator and left the interior of the structure in a shambles. Not until 1911 was a new building for these testing purposes erected on the Cliff Street site. A new comparator was installed, designed by C. E. Guillaume, Assistant Director, International Bureau of Weights and Measures. Plans of the apparatus were provided by *La Société Genevoise pour la Construction d'Instruments de Physique et de Mécanique*. In 1925 this Surveys Laboratory, as it had been known, was renamed the Physical

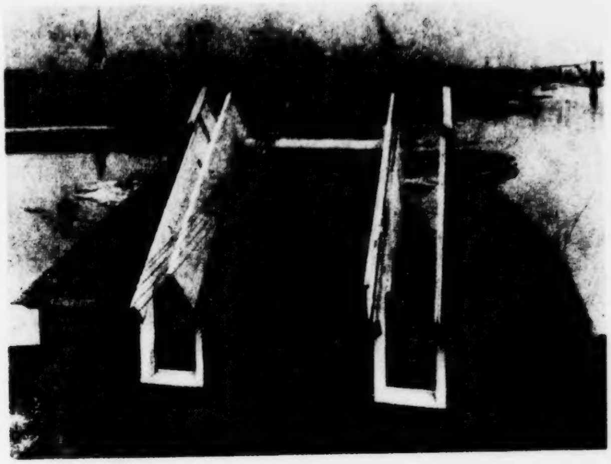


FIGURE 1
Cliff Street, Ottawa, pioneer instrument-testing laboratory and survey reference point, about 1911. Central Hull and Interprovincial Bridge in background.

Testing Laboratory. "A surveys laboratory for testing instruments has lately been built", Deville reported, "and it has already proved very useful. Although only a portion of the equipment has been installed, facilities will be provided for testing and adjusting surveying transits, levels, aneroid barometers, measuring tapes, etc., and for rating chronometers and watches".[3]

Much of the notable work carried out by the Dominion Lands Surveys organization in the West owes its excellence, in part, to practice work at the Cliff Street site. As instrumental precision was of greater consequence to Deville than any consideration of human comfort, the only source of heat in the building during winter months was a gas stove in the front office. In later years it was found that the premises could be warmed by electrical heating without adversely affecting precision tests. Telescopes were also tested for their optical properties. Judging from the number of flaws detected in instruments by investigations in this laboratory it soon became apparent that the relatively small cost of providing a reliable test of a surveying instrument before accepting it from a dealer, was a sound investment.

G. Blanchard Dodge, as Chief of the Special Surveys Division, Department of the Interior, supervised the Cliff Street project but W. H. Herbert was placed directly in charge of its operations. He was succeeded in 1913 by W. C. Way. Soon after Way became supervisor a new tape comparator building was erected in the New Edinburgh district of Ottawa. Way was personally responsible for important improvements made in aneroid (survey) barometers, devised as a result of experiments conducted in the new premises. These instruments, in conjunction with better systems of barometric levelling, began to make possible the production of highly useful information on heights for contouring purposes. Mr. Way also developed a reliable method of testing telescopes intended for use on surveys. In 1927 a notable advance was made in the Physical Testing Laboratory when verification of the Dominion Standard Yard was achieved.

In 1921 Frederic Hatheway Peters (1883-), who became Surveyor General three years later, sponsored the establishment of an instrument repair shop at the Laboratory, fulfilling previous unsuccessful efforts made by Dodge, Deville and Way

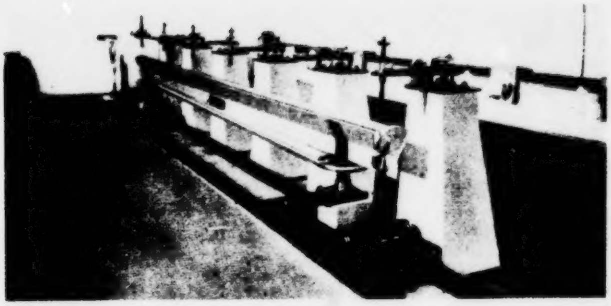


FIGURE 2
Comparator in Standardizing Building, Ottawa, about 1915.

to meet this special need. Soon the laboratory was assigned the tasks of repairing and testing dashboard instruments for the Royal Canadian Air Force and, in fact, began to assume an important place in the genesis and growth of air surveying in this country. Laboratory calibration of ground-survey cameras had been instituted by Deville and the same methods were readily extended to apply to the earliest air cameras to be used in Canada. Stereoscopes and other instruments employed in the first air-survey operations in this country were designed and constructed in the Laboratory shop. Means were provided for the purpose of intercomparing rules used as standards of measurement and for verification on base standard tapes of any length.

By 1929 Reginald Hugh Field (1890-   ) had succeeded Way as supervisor. Field later became president (1943) of the Canadian Institute of Surveying. He was a prolific contributor of technical articles to *The Canadian Surveyor* and other publications. The independent existence of the Physical Testing Laboratory came to an end in 1931 when it became part of the then newly-established National Research Council Laboratories. It was mainly owing to Deville's determination to maintain instrumental equipment at the highest possible level of precision that brought into existence testing facilities in Canada long before light waves and radar beams became available for these important purposes. On the wider scene Deville persuaded government authorities in Ottawa to arrange for Canada's membership in the International Bureau of Weights and Measures (*Bureau de National des Poids et Mesures*). Canada thus became the first member nation of the British Commonwealth, apart from Great Britain, to belong to this world organization.

Air Photographic Surveys

During the First World War the aeroplane underwent major changes in the race of combatant nations to develop the heavier-than-air machine into a military weapon. Improvements in propeller shape, power plant and body design were greatly accelerated in this violent and fiercely competitive environment. In appearance, in its greater flight stability and control the aeroplane of 1918 was an age ahead of the flimsy, kite-like *Silver Dart* which, in February, 1909, at Baddeck, Nova Scotia, was the first plane to be flown within the British family of nations. In addition, as a result of practical applications of photography to the exacting tasks of military observation, a number of refinements had been made to air cameras. At the end of the war several significant factors combined to attract official attention to the aeroplane as a means of expediting and advancing the scope, range and general effectiveness of land-survey work. Developments in aerial photography during the war years convinced surveyors generally that the new technique could be applied to all aspects of topographic surveying. At the conclusion of hostilities warplanes became available for peacetime uses and a number of such aircraft, including a few flying boats, were turned over to Canada by the British government. It was obvious, too, that trained pilots and navigators, former air force officers, could form the nucleus of a civilian flying service. Another significant element in the post-war situation was the formation in June, 1919, of an Air Board in Canada. Here then, in timely conjunction, were the four principal ingredients indispensable to the successful growth of air surveys (or "aerial phototopography" as it was then described); the aeroplane, the air camera, pilots and navigators and, above all, an organization capable of providing national support of the enterprise at the official level in Ottawa.

In the forefront of revolutionary developments in the fascinating and promising new field of air surveying, and soon to be named to the reconstituted Air Board, was Dr. Edouard Deville.[4] Initial work in the application of aerial photography to survey projects, accomplished in the autumn of 1918 and involving the participation of Canadian Naval Air Service officers, was continued under auspices of the Air Board.[5] In addition to the creation of the Board, an Air Survey Committee of the Department of the Interior, with Deville as chairman, was established and shared with the Board the responsibility of assessing practical possibilities of air photographic surveying. It was decided that an experimental aerial photographic survey should be undertaken in the summer of 1920.

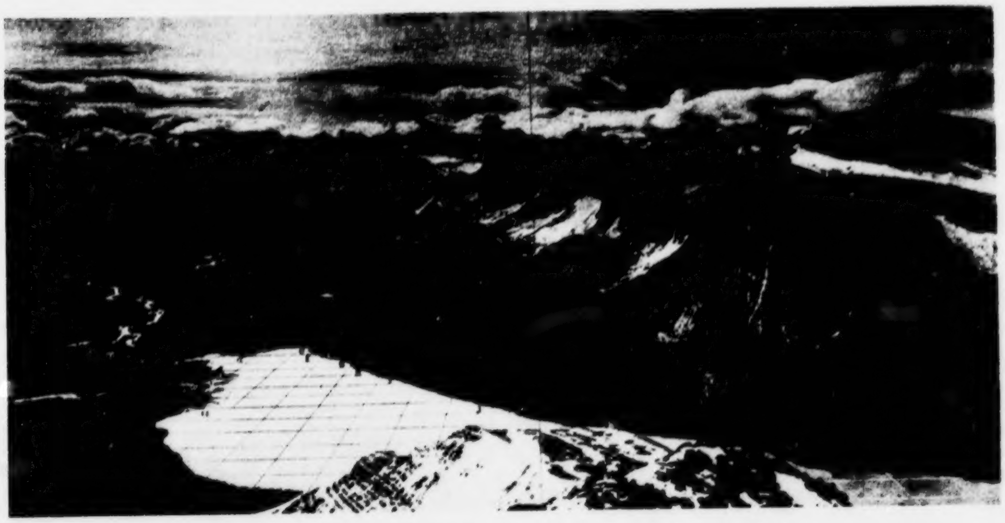


FIGURE 3. Photograph taken in Canadian Rockies portraying use of perspective grid in map plotting.

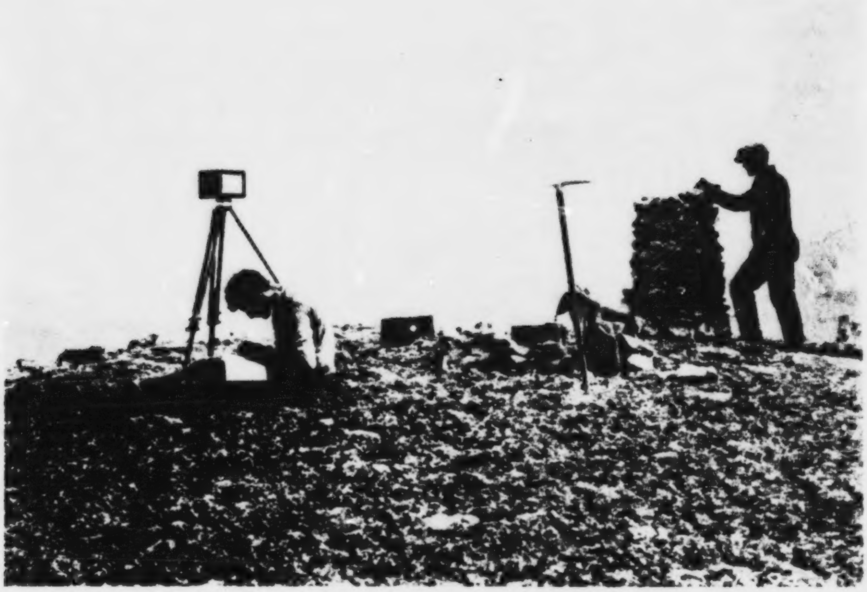


FIGURE 4. Surveyors marking site of a photo-topographical mapping station with stone cairn in mountain country, 1929.

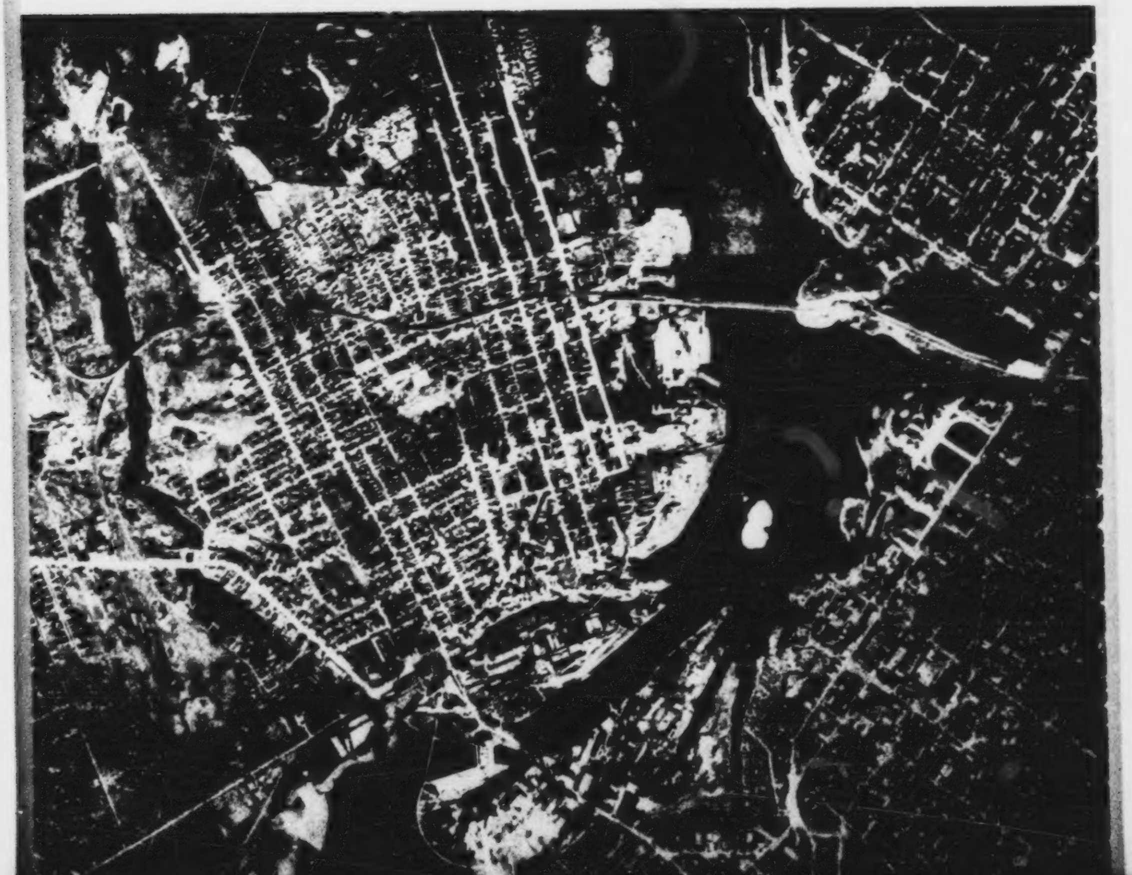
Ottawa and area offered physical features particularly favorable to such a test. In the district land and water occurred in fair proportions at varying elevations and all within a reasonably small compass. It was considered essential that a control survey of the region should be first undertaken so that various points and elevations could be accurately fixed by triangulation. By this means it was intended that the relative positions of photographic prints making up a mosaic, could be fixed and controlled to the highest possible degree of accuracy. It was also hoped that data could be obtained by which photographs, badly distorted by the tilt of the camera plate to the horizontal, would be rectified. In all these activities the navigator was the key man in the operations and the best stabilizing device a plane could possess was its pilot. At the beginning Dominion land surveyors such as R. D. Davidson, Eric Fry and John Carroll acted as air navigators and photographers.

Two flying charts were prepared for the guidance of each pilot on the experimental surveys, one for flights at 6,000 feet and the other for flights at 10,000 feet. These charts were necessary to help keep the plane on course, to tell the pilot where to start and stop the camera, and to maintain the proper separation between parallel flights. In these early stages of the project attempts were made to join the edges of photo prints but the existence of different scales and of image displacements due to ground relief did not always permit close coincidence.

An interdepartmental conference met in Ottawa late in 1920 to draw up a program of air-survey work for the following field season. The gathering took place in an aura of optimism resulting from epochal events in aviation that had caught the public imagination, achievements such as the first non-stop flight across the Atlantic Ocean, west to east, in June, 1919; and by the first trans-Canada flight, made from Vancouver to Halifax in October, 1920. The latter feat occupied a total of ten days (October 7 to 17), the actual flying time being 49 hours, 7 minutes. In addition to members of the Air Board this conference was attended by the Superintendent of the Geodetic Survey of Canada, the Controller of Surveys of the Topographical Surveys Branch of the Department of the Interior, as well as by several other key departmental officials. The committee noted with satisfaction the completion of air photographic surveys during the summer of 1920 of Vancouver harbor and of the Fraser River delta region, of water storage basins in southern Alberta for the International Joint Commission, and of a mosaic of airphoto prints of the St. Croix River.[6]

In the pioneering stage of air camera work in Canada the value of the mosaic sheet was not fully realized. But before long it was found that the more the mosaic was studied, the more information it yielded. It had the definite advantage also of being more easily read and understood by the public than a map, although it was not as useful as the latter when precise measurements were required. Very early in the experimental program in this country it became clear that aerial photography would revolutionize topographic surveying, although some system of triangulation control remained indispensable to successful operations. For a time the problem of maintaining effective, constant communication between pilot and photographer, so essential in this type of flying work, remained unsolved. Experimental flights revealed that the Bristol Fighter aircraft, providing good

FIGURE 5. Mosaic based on 1925 RCAF photography of parts of Ottawa and Hull from 10,000 feet. Approx. scale: 1,200 feet to the inch.



visibility in all directions and capable of taking photographs at 20,000 feet, possessed the most satisfactory characteristics for air-survey work.

In the 1921 season the scope of this work widened considerably. In that year, at the request of the government of Ontario, a mobile unit was established on the National Transcontinental Railway between Sioux Lookout and the Ontario-Manitoba boundary for a distance of 200 miles east of the interprovincial border. During that same summer a large area of Ontario was surveyed from the air by forest engineers of the Ontario government service. Complete and accurate maps were then prepared, showing the nature of the country photographed in considerable detail. Other important air surveys accomplished in 1921 included areas adjoining the proposed St. Lawrence Seaway. These activities, requested by the International Joint Commission, provided highly satisfactory representation of the ribbons of land portrayed. The results were most useful in the revising of existing maps and in the preparation of new sheets. Especially valuable photographs were obtained during the same season of principal streams flowing east from the Rocky Mountain watershed. Used in mosaics these photographs were particularly helpful as information in support of water conservation studies of the western interior. The most impressive aspect of all these operations was the fact that, after only four months of flying, information was available for surveys and mapping that would have consumed years of effort without the use of aircraft. The end of 1921 marked the conclusion of a period of preliminary organization and experimentation in Canadian civil aviation. In the service of governments the usefulness of aircraft in forest survey and forest protection work had been proved beyond question. This new method of travel was particularly helpful in providing rapid transportation for surveyors and others across vast, unsettled regions of northern Canada.

In January, 1922, an interdepartmental conference in Ottawa on the subject of the use of aircraft by federal government services was attended by Surveyor General Deville and representatives of the Geodetic Survey Branch and Topographical Surveys Branch of the Department of the Interior, and by the Director of Geological Surveys of the Mines Department. It was decided that in 1922 there would be a continuation of air transportation of survey parties and their equipment from Vancouver eastward along the Fraser Valley and of supplies to survey parties in northern Manitoba and Saskatchewan. There was to be, as well, photography from the air from Jasper along the continental watershed forming the British Columbia-Alberta boundary in conjunction with similar flights for the Geodetic Survey. Similar flights were to be made in aid of survey parties along the north shore of the St. Lawrence River from Clarke City to the Straits of Belle Isle. It was also decided to construct a mosaic of a complete township in the Calgary district for comparison with results of ground surveys undertaken in the same locality.

For the Topographical Surveys Branch, Interior Department, mosaics of the Bow River west of Calgary and of the Moose Mountain Reserve were made for the purpose of providing topographical detail in connection with surveys of those areas. Mosaics were prepared by the Branch based on air surveys carried out at a number of different stations. All photographs were compared with existing maps of the same areas and where the latter were incomplete, revisions were made in them from information gleaned from the photographs.

The veteran surveyor and author, A. O. Wheeler, asked for an opportunity to fly over stretches of the British Columbia-Alberta boundary line as an observer on reconnaissance flights during the 1922 season. He clocked nearly twenty hours of flying time in this connection. "As a means of mountain reconnaissance", Wheeler reported, "the aeroplane offers exceptional facilities. Given a clear day and the ability to keep known landmarks it is, to a topographer, a study of a living map, the most accurate that can possibly be had. I was enabled to get a clear conception of the country my future [land] surveys would cover and the nature of the access to them . . . I may say that the aeroplane service can be applied to distant and difficult surveying work with great advantage and I should think could be used as a means of saving expense".[7]

FIGURE 6. A. M. Narraway

For the Topographical Surveys Branch, Athos Maxwell Narraway (1888-   ), Controller of Surveys, Department of the Interior, was flown a total of 14 hours between July 3 and 11, 1922. These flights demonstrated how survey inspection work could be simplified and extended. An extract from his report on these flights conveys vivid impressions of his experiences:

"The flight, consisting in the neighborhood of 1,100 miles, mostly over unmapped territory, commenced at Victoria Beach, Lake Winnipeg, and ended at The Pas. No mishaps or delays occurred and the trip was made in ten days, including six days at surveyors' camps. By ordinary methods of travel this inspection work would have taken practically the whole season and would have been expensive.

"The first survey party to be visited was engaged in the surveying of the Manitoba-Ontario boundary. No reports had been received from this party and as they were in unexplored and unmapped territory only an approximate idea could be formed as to their location. A very conservative estimate of the time that would be required in reaching this party by ordinary means of travel would be somewhat over two weeks and would have entailed considerable paddling and searching out routes and portages, the usual endless contest with mosquitoes, the difficult task of finding the party and a very restricted view of the country traversed. The trip was actually made in one hour and forty-five minutes and permitted of the sketching of the main topographical features, examination of the forest growth and by flying low, an unobstructed view of the completed boundary line . . . The camp was located without difficulty by the smoke from camp fires and a very easy landing was effected, ending with the machine tied to the trees less than twenty feet from the tents".[8]

Narraway was especially enthusiastic in describing that part of his northern trip from The Pas to Churchill River:

"Flying over the course of the survey [of waterways of the region] oblique photographs were taken by the K2 camera at intervals of about two minutes. In some of the photographs the survey pickets are clearly discernible and in all of them the prominent land features surveyed can be accurately located. Using the survey of these main features as a control, the details of the shore line and the intricate mass of islands can be filled in from the photographs with accuracy consistent with the requirements. The surveyors [on the ground] were obliged to spend considerable time mapping the shore-line detail and islands, and even then could only obtain what was confined between the two shores. With the plane, the time required to get in the details, can be estimated in minutes instead of hours, and in some cases, days, and the scope of the camera widens the survey to several miles on either side of the waterway and includes lakes and topographical features which otherwise would be left unmapped.

"As a result of this trip I am of the opinion that invaluable service to surveying in unexplored and unmapped territories will be rendered in the future by the seaplane in transporting supplies and men, thereby saving for the work many days of the working season, which is already short enough; in permitting reconnaissance and exploratory flights for purposes of planning surveys; in keeping in communication with the surveyors during the season and in taking photographs along the course of the survey for filling in detail.

"To those who have a thorough knowledge of the ground conditions and experience in sketching and mapping such as surveyors have, the value of flights over the districts to be surveyed can scarcely be overestimated".

On Narraway's return to Ottawa a systematic examination was made of photographs taken on his inspection tour with a view to evolving a method of transferring the illustrated topographical information to existing maps of the areas covered. Some highly favorable results were obtained, foreshadowing far-reaching reconnaissances by air in the exploration and mapping of large areas of northern Canada.[9] It was in this period of air photographic work that surveyors such as R. D. Davidson, John Carroll and Eric Fry played such an active, useful and pioneering part.

It was now apparent that in an unsurveyed country, possessing no great variations of elevation but some form of geodetic control, topographic detail of an entire district or region could be filled in from air photographs with a speed and accuracy unobtainable by the most exacting ground surveys. Because Canada was in possession of such an immense unsettled territory over which aircraft could operate with great advantage, it was inevitable that aviation would play an increasingly valuable role in the surveying and mapping of the country. We have seen that some of the most useful services provided in this manner included fast, reliable and relatively easy transportation and maintenance of survey parties in the field in remote places, surveying by aerial photography and sketching, as well as mapping from the information supplied by air photographs. In 1922 alone some 2,000 photo prints were supplied by the Air Board to the Topographical Surveys Branch.

Meanwhile Deville worked diligently on the perfection of a camera which, when suspended from an aeroplane at right angles to its line of flight, would be capable of photographing terrain from horizon to horizon. It was also desirable that when the plane banked during the photo-making process, the horizon line would indicate in any one photograph the direction and extent of tilt, information essential to any effective plotting of maps based on a set of photographs produced by the air camera. At this time the Topographical Surveys Branch did not possess any instruments capable of facilitating plotting from photographs. At Deville's request the Air Board authorized a series of experiments on a new camera and system of air survey devised by H. L. Cooke, Professor of Physics, Princeton University. For mapping purposes he proposed the use of low oblique views of a single area photographed from two different air stations. Although Professor Cooke's method was sound in theory, suitable photogrammetric equipment, such as a special convergent plotter, was not then available. There are indications that the photographs produced by the Cooke method proved difficult to process. In any event vertical or near-vertical (low oblique) air photography could contribute little toward reconnaissance mapping of Canada's northern areas because of the limited amount of ground that could be covered by a single exposure. Only flying boats could be used effectively in vast wilderness areas, largely devoid of landing strips yet interlaced with innumerable waterways. This type of aircraft could operate, however, only under relatively low ceilings, varying between 6,000 and 8,000 feet. By the standards of the 1960s the cameras in use were narrow of angle.

In the summer field season of 1922 an official probe of Canada's Far North was launched from Ottawa with a view to ascertaining the extent to which aeroplanes could operate efficiently in Arctic conditions for transporting, surveying, mapping and other purposes. A Dominion land surveyor (1914), Squadron Leader Robert Archibald Logan, was appointed to carry out this investigation. On July 18 he sailed aboard C.G.S. *Arctic* from Quebec City, returning on October 2 to that port after visits to Bylot, Ellesmere and North Devon islands and to the north end of Baffin Island. An experienced flying officer and well qualified in meteorology and aerial navigation, Logan submitted a comprehensive report to the Department of the Interior Provided there were machines adapted to the special conditions in the Arctic and operated under proper precautions, it was evident that planes could be used to advantage in the far northerly latitudes of Canada.[10]

In 1922 Fairchild Aerial Surveys Company (of Canada) Limited was formed with head offices at Grand'Mére, Quebec. The Fairchild aerial camera was generally considered, at the time, as the most perfect and most modern instrument of its type. It had been adopted as a standard by the Royal Canadian Air Force and by the United States Army and Navy Air services. Utilizing its own Curtiss Seagull flying boat the company produced a complete mosaic of 320 square miles of unmapped forestland in the Rouge River valley of Quebec. Strip mosaics were also made of the Batiscan River covering a number of projects for the development of water power, including the location of related power lines. Complete mosaics were also produced of Trois Rivières and Grand'Mère for town planning purposes.

At this stage in the growth of civil aviation in Canada references began to appear concerning the use of the Fairchild stereoscope, an instrument enabling the observer to look simultaneously at a pair of air photographs and view the pictured terrain in three dimensions. The stereoscope, for example, made it possible for a timber limit owner to study in detail any section of his forest domain. In vertical air photography a new type of Fairchild camera, gyroscopically controlled, was put into use in 1923.[11] It is interesting also to note that in the same year hyper-sensitized, panchromatic film was being used in air survey work but with exposures at speeds only one-quarter as fast as those occurring forty years later.

On January 1, 1923, when the Department of National Defence came into being as such, the Air Board of Canada ceased to exist as a separate entity. Annual reports of the Board were supplanted by annual reports on Civil Aviation in Canada. Experimental oblique stereoscopic photographs were taken during the 1923 field season in the vicinity of Ottawa and vertical stereoscopic photos were taken along Sheep Creek, Elbow River and Beaver Creek in Alberta. Two other flights were made over the course of the Ontario-Manitoba boundary and three parallel flights took place over the New Glasgow, Nova Scotia, sheet area. Up to the end of this particular field season more than 4,500 photo prints were supplied by the Royal Canadian Air Force to the Topographical Surveys Branch, Ottawa.[12]

In the winter of 1922-23 Canadian Vickers Limited had undertaken work on several equipment supply contracts for Canadian civil aviation firms, including the construction of floats for seaplanes and skis to serve as winter-landing gear. During that same winter season experimental flights clearly demonstrated that cold-weather flying was feasible.

As an appendix to the 1924 Report on Civil Aviation, a report by H. K. Wicksteed was included on the use of air photography in railway location work.

During the 1924 field season, as a result of successful operations in the several previous years, aerial methods of mapping on a large scale were adopted. No less than 9,000 square miles of territory were photographed from the High River, Alberta, air station. The photographs were then plotted in the drawing offices of the Topographical Surveys Branch. Maps of the district were then revised on the basis of the new information made available. Land surveyors were enthusiastic over the advantages of airphotos in guiding their efforts, a service that cut their ground work in half. A mosaic covering 520 square miles of the Edmonton area was produced after four flights. Edmonton's city engineer at the time, on receiving copies of the mosaic, was greatly impressed by the possibilities of their use. "One of the striking features of the map", he stated in a written report, "is the way in which one can visualize the density and distribution of settlement. This is particularly useful in Edmonton where the fundamental problem was brought about by over-expansion. The photographs show at a glance the accurate location of all settlements and these could be obtained by ordinary survey methods only after laborious field work . . . I have been in fairly close touch with the Dominion land surveyor who was carrying on the work in connection with the survey of the district and I can see that in his work there is a remarkable saving of time and labour by having available the aerial photos . . ." By September, 1924, the whole of the Edmonton sheet map, 3,224 square miles, had been photographed from the air in 14 flights totalling 32 hours.[13]

Exceptional foresight was exercised by Deville, Peters, Narraway and others in the earliest days of aerial photography in Canada in laying the foundations of the unique organization that came to be known as the National Air Photo Library.* In 1920 the

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*Known, until 1948, as the National Air Photographic Library.

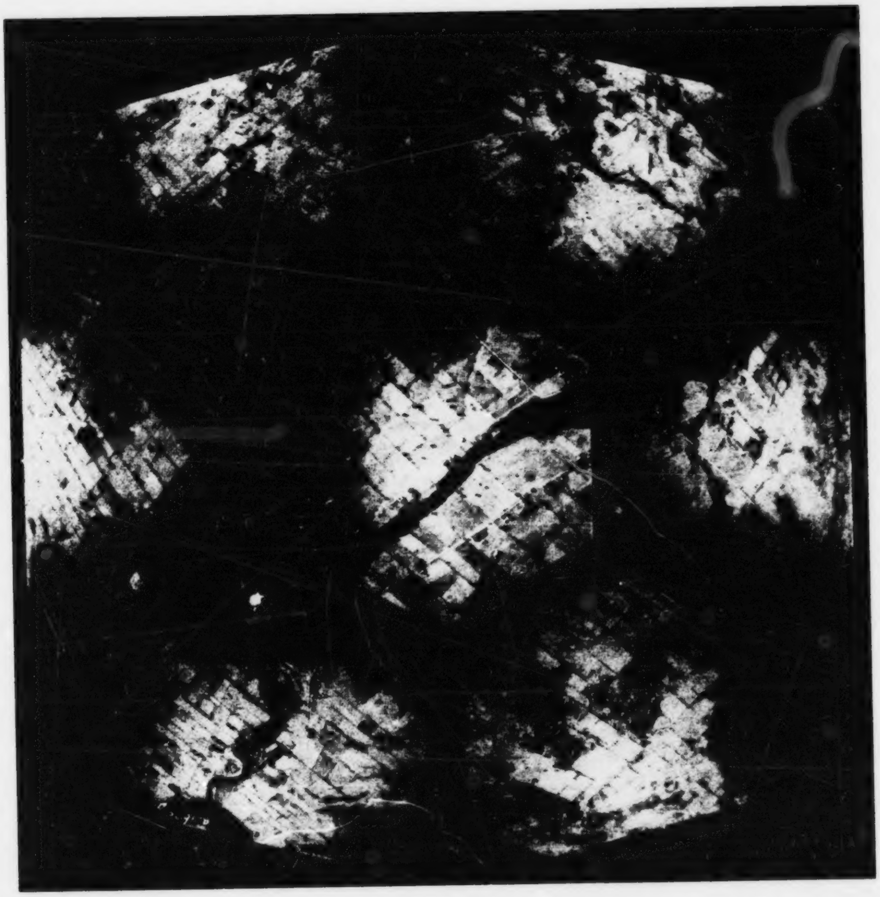

FIGURE 7. Air view of Burritts Rapids on the Rideau River, Ontario, taken by a seven-lens Barr-Stroud camera at 7,200 feet, 1937.

printing and developing of air photographs and the mounting of mosaics was performed by the staff of the Natural Resources Intelligence Branch, Department of the Interior.[14] The Library was formally established on February 7, 1925, but the need to provide for systematic filing and storage of negatives and prints was recognized at least five years previously when the first experimental photographic flights in Canada took place. Later on as the Air Force became more involved in this type of air surveying activity, the processing, printing and storage operations became functions of the Library staff. By the 1960s files of the Library were accommodating several millions of photographs, providing an aerial portrayal of all Canada, pictorial information vital not only to map makers but to all interested in the development of the nation's natural resources. Air survey photos, in fact, became a rich, varied and sometimes sole source of knowledge essential to the wise planning, construction and development of settlements and of engineering projects across the 1,800,000 square miles of northern Canada.

In time, then, the National Air Photo Library came to serve, not only as a central repository of all aerial photographs taken under the auspices of various federal government departments in full liaison with the provinces, but as well the most complete rapid reference service and most comprehensive storehouse of air photographs known to exist anywhere in the world for the benefit of all users.

In Deville's life span he had witnessed the steady development of Canada from a loose collection of seven provinces to a more unified political and economic entity extending from the Atlantic to the Pacific, on the verge of attaining full independent nationhood. The science of photography, during his lifetime, had progressed from the stage of daguerreotypes to the sophisticated, high-speed air camera using hyper-sensitized panchromatic film. Aeronautics had developed from the pioneering experimental flights of the Wright brothers and of McCurdy to planes capable of crossing the Atlantic nonstop. In the realm of transportation generally Deville had witnessed the institution of regular transcontinental service as well as the use of planes in place of the canoe and Red River cart. The whole field of long-distance communications had been so revolutionized as to make surveying and mapping of the vast, unoccupied areas of Canada immensely easier and more accurate.

Deville, married at the age of 32 to Josephine Ouimet, daughter of the second premier of Quebec, never shared her preoccupation with the unending round of social events in the nation's capital. In the closing years of a career completely dedicated to his work Deville was immensely saddened by the deaths of respected colleagues with whom he had close associations in the public service. As he commenced his 40th year as Surveyor General, Deville's legendary good health and sturdy powers of endurance began to decline noticeably. By the advent of summer he had become frail and bedridden.

The maples outside his Ottawa home blazed with vivid autumn colors as the mellow September days of 1924 drifted by. Downtown the film "Monsieur Beaucaire", starring Rudolph Valentino, played to capacity houses. Preparations were under way on Parliament Hill for the approaching visit of the Prince of Wales to Ottawa; Dr. Charles E. Saunders, discoverer of Marquis wheat, had just returned to the capital after a stay of several years in Europe. Daily papers were drawing public attention to the fifth anniversary of the League of Nations. At 60 Lisgar Street, Edouard Deville's life force ebbed steadily as his wasting illness took its inevitable toll of strength. On Sunday, September 21, the pace of decline became suddenly more rapid. Late that evening he died. Josephine and their only son, Gaston, were at his bedside at the end.

In the passing of Canada's Surveyor General the capital, the nation and the world lost the services of a man who stood for the highest standards in the application of scientific principles to problems of land measurement, as well as the loftiest ideals of reliability and accuracy in the discharge of public responsibilities. Thomas Shanks, who had been associated with Deville for a quarter-century in the strenuous work of the department, paid stirring tribute to Deville's personal integrity and his mastery of the tasks of administration. Shanks drew attention to the fact that although French was Deville's mother tongue, he succeeded in cultivating the qualities of terseness, fluency and clarity in his use of the English language.

J. J. McArthur, as president of the Dominion Land Surveyors' Association, had once described Deville as unflagging in his efforts to "raise the standard of Canada's surveying operations and to perfect the organization of Dominion Land Surveyors". The

Board of Examiners of the Dominion Land Surveyors observed that Deville had been responsible "in no small degree for the high position which Canada holds today in the world of sciences". Associated with the work of the Board as a member since 1879 Deville "may well be regarded as the founder of an important national profession. Through his initiative and masterly direction there had developed a system of survey almost unique in its extent, efficiency and accuracy. Throughout his career Dr. Deville brilliantly represented his country at scientific conferences abroad and became internationally known and recognized. Indeed, in several branches, such as photographic surveying and the science of optics, he was regarded as one of the greatest authorities of his time, and his influence extended to every country where advanced science was cultivated".[15]

This chapter would be incomplete without a tribute also to the energetic devotion to their challenging tasks of the personnel, flying and ground, of all air photographic services; federal, provincial and commercial. The outstanding record of gallantry, efficiency and dependability established by Canadians in the Air Force during the First World War was carried into the era of peace. No country was better served by aviators in post-war years than Canada. Much of their pioneer work was accomplished under arduous conditions, without adequate facilities, sometimes from remote bases, with small staffs and, on occasion, with obsolescent aircraft. But a new generation of pilots, navigators, air photographers and mechanics was being shaped in the crucible of experience. A stirring future awaited these young men, who felt, if they did not voice, a conviction well expressed in the prophecy:

> *"The air flows over both land and seas; more than either land or sea it is the place of vision, and of speed and freedom of movement. What we of this generation are witnessing is a process whereby the air shall come into its own. It will become a great highway for the traffic of peace."*

2

SURVEY INSTRUMENTS: ANCIENT AND MODERN

> *"A good instrument man, it may be said, has the sensitive touch of the surgeon, a sense and understanding of things mechanical, a sound comprehension of the principles of geometry, the language of a mule-skinner and the back of a pack-mule."*
>
> —Lester C. Higbee, W. and L. E. Gurley Company.[1]

Land surveyors in the earliest civilized communities in the Nile Valley left to posterity evidence, both direct and indirect, of the elementary instruments employed in the practice of their profession. There are sound reasons for the belief that in sighting, for example, and in meridian determination Egyptian practitioners of the surveying arts used a plumb bob, observed through a slit in a palm leaf. For levelling operations a plumb bob, suspended from a triangular frame, served their purposes. For right-angle measurements a carpenter's square and a type of surveyor's cross were used; for direct measurements, an ordinary rope. Much credit belongs, therefore, to these trail blazers of history whose observations and calculations, aided by primitive tools, made possible the construction of the pyramids, durable masterpiece of geometrical precision involving the application of technical skills and engineering abilities of a high order.

The earliest book in which first principles of surveying as well as descriptions of surveying methods and instruments were set forth was the *Treatise on the Dioptra*.[2] This was the work of Hero of Alexandria, a Greek scientist who wrote on various mechanical devices at the dawn of the Christian era. The *dioptra* was mounted on a Doric column with three small legs at the base. This support was made vertical by a plumb bob and, at the top, a toothed half-circle was turned by a worm-gear for the final levelling of the instrument. For angle work a horizontal circle was provided with an open sight and four right-angle graduations. For levelling, a water tube with proper sights was attached.

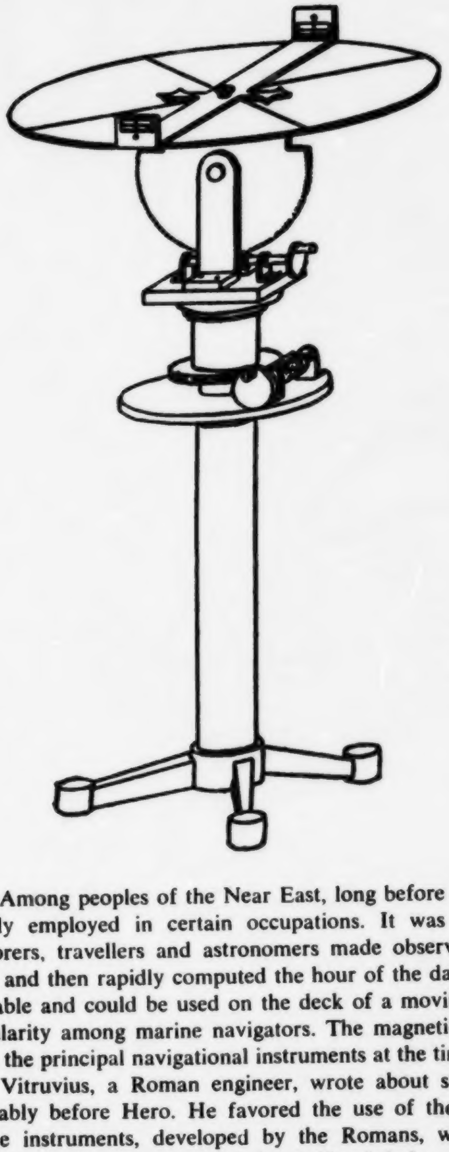

FIGURE 8
Dioptra of Hero of Alexandria, as reconstructed.

Among peoples of the Near East, long before the birth of Christ, the astrolabe was widely employed in certain occupations. It was a paramount instrument by which explorers, travellers and astronomers made observations of the altitude of the sun or stars and then rapidly computed the hour of the day or night. Because the astrolabe was portable and could be used on the deck of a moving ship it enjoyed considerable initial popularity among marine navigators. The magnetic compass and the astrolabe, in fact, were the principal navigational instruments at the time of Columbus.

Vitruvius, a Roman engineer, wrote about surveying instruments about 15 B.C., probably before Hero. He favored the use of the *chorobates* for levelling operations. These instruments, developed by the Romans, were based on the principle that the surface of a liquid in repose is level. Plumb bobs were used in the *chorobates* in place of the water tube employed in the *dioptra*. But a trough was cut in the top of the device and this could be filled with water when wind interfered with the bobs. Essentially this was a form of triangular frame with a plumb bob suspended from the apex, a type of level that can be traced back to ancient Egypt and even to Assyrian times.

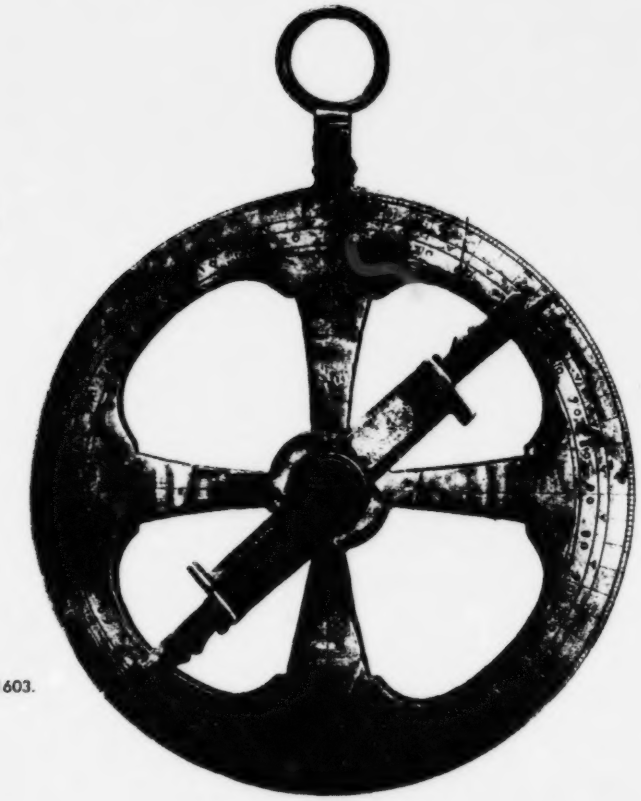

FIGURE 9
Champlain's astrolabe, 1603.

Generally, however, the ancient surveyor lacked survey instruments of reliability and precision. For measurements of length he used ropes and rods, whose units had not been standardized. Records of surveys were also indifferently recorded, if at all.

It was in the Low Countries, in all probability, that the astrolabe was first employed on European land surveys. By its use the first triangulations were undertaken in the western world and the relative positions of towns fixed. The accuracy of such surveys depended upon the precision with which the instrument could be set up in the meridian, and upon the accuracy in those early days, of the division of the circle. The astrolabe and cross-staff, described in Volume One of this history, were forerunners of the sextant which enabled travellers and early navigators to measure the sun's altitude and thus determine the latitude of the observer. Instead of exposing the observer's eyes to the full glare of the sun and to remove the necessity of having a steady hand, John Davis invented what came to be known as the Davis quadrant. In time this instrument was displaced by Hadley's improved quadrant.

For some time after discovery of the New World, explorations were carried on with the aid of marine instruments. It is hardly surprising, therefore, that Samuel de Champlain made use of an astrolabe to guide him in his penetrations of the interior of New France. But in 16th Century Europe the practical surveyor in the field must have found that astrolabes were cluttered with appendages of little or no use to him. Artillery officers, seeking to get range of enemy positions as quickly as possible, could also dispense with facilities of the astrolabe for finding the place of the sun in the zodiac or for ascertaining the times of conjunction or opposition of the planets.[3]

Accomplishments in the development and construction of instruments were the primary contributions of continental Europe in the 14th and 15th centuries to the arts of surveying. Improvements in the magnetic compass, the invention of the holometer (which, in time, led to the adoption of the "plain table") and, in England, refinements of astronomical instruments as well as standardization of units of land measures featured this period. The method of surveying land by triangulation, as promoted by Frisius, was also an important step forward in those times. With this latter development came a steadily increasing demand for instruments by which the new practices could be advanced.

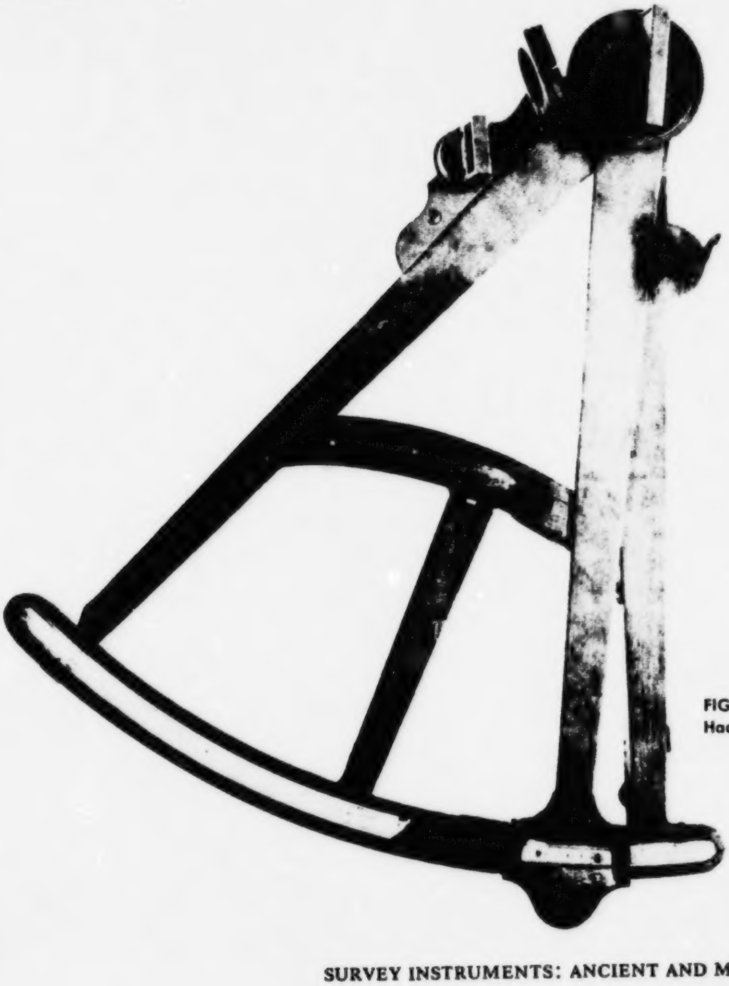

FIGURE 10
Hadley's quadrant.

The Englishman, Leonard Digges, wrote a book that was published in 1556 and in which three surveying instruments were mentioned, namely, the geometrical square on the side of a ruler, the carpenter's square, and the cross-staff. Digges failed to mention any instrument used for measuring direction but did refer to poles and cords for measuring distance. A second book of his, published by a son in 1571, mentions "the theodelitus" and "instrument topographicall". The latter device, combining the geographical square and theodelitus, provided a means by which angles in horizontal planes as well as angles of elevation could be determined. For almost two centuries the style or type of theodolite, as pictured in Aaron Rathborne's *The Surveyor*, 1616, retained the same general appearance. John Johnson, an American surveyor, used, for example, a theodolite of ancient model in his 1818 surveys of the New Brunswick-Maine boundary.[4]

An early improvement in distance-measuring instruments was Rathborne's "decimall chaine", made of round wire and curtain rings and with its 198 inches divided into ten equal parts or *Primes*. This chain was a distinct advance over cords and wooden poles previously used and a useful forerunner of the chain invented in 1620 by an English professor of astronomy, Edmund Gunter (1581-1626). Rathborne also mentioned an instrument representing a refinement of the astrolabe, namely, the circumferentor. As recently as the 1760s the circumferentor was employed by Mason and Dixon on their celebrated surveys in the New World.[5] In fact, early in the 19th century it formed part of the equipment of the Lewis and Clark expedition.

A relic recently uncovered in Oxford, England, ostensibly made in 1586 by the distinguished instrument maker, Humphrey Cole of London, is of special significance in the history of survey instrument construction. It is the earliest existing example of a combination of the pioneer topographical instrument and the primitive theodolite.[6] Its appearance marked the beginning of modern survey instrument design not only in England but in the civilized world. The search for a universal instrument for angle measurement was about to end in success.

Ralph Agas (1545-1621) was one of the first English land surveyors to make use of the plane table and a theodolite of the type described by Digges. Agas, in his field notes, also mentioned his use of a circumferentor. The improved surveying methods used by Agas and others suggested the need for scales by which distances and angular measurements could be read with greater ease, clarity and precision. It was then that instrument makers began to borrow ideas and methods from astronomers for the construction of scales for reading distances and angles with fair accuracy. In England, in the matter of survey instruments, the 17th century was, in fact, mainly important for the development of scales and for the appearance of the land measuring standard, Gunter's chain.

The family name of Dolland became synonymous in 18th century England with important advances in the science of optics. John Dolland, a silkweaver who had fled from his native France, although deprived of schooling at an early age, managed somehow to attain proficiency in optics and astronomy. His eldest son, Peter Dolland (1730-1820), founded the London firm that became world-renowned in the manufacture of instruments useful in surveying. In 1750 Peter established a shop near the Strand and concentrated on the manufacture of optical instruments. This enterprise proved to be highly successful. The elder Dolland forsook his silkweaving activities to join his son in the venture. In the course of time several Dollands made valuable contributions to the new science, inventing and improving a number of optical instruments. Their products were considered among the best made in England and were widely used in the British Isles and abroad.

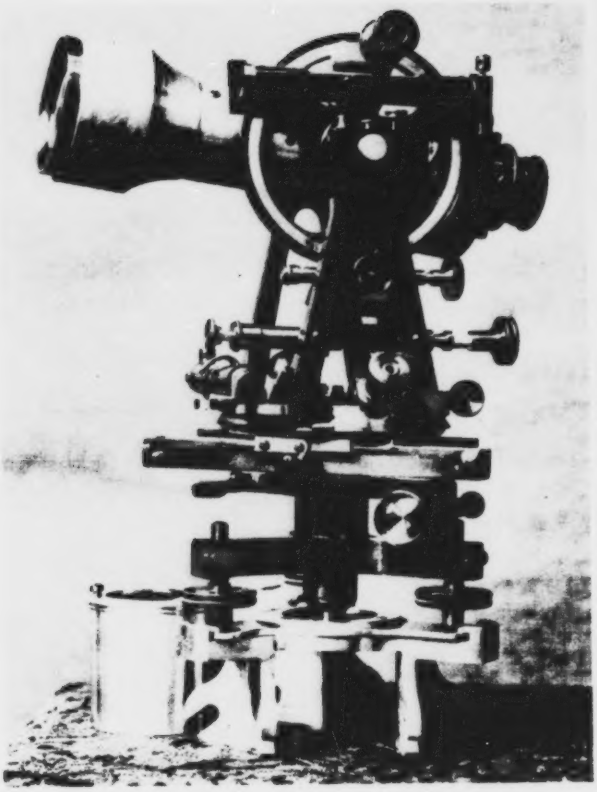

FIGURE 11
Early type of modern theodolite ("S.G." type).

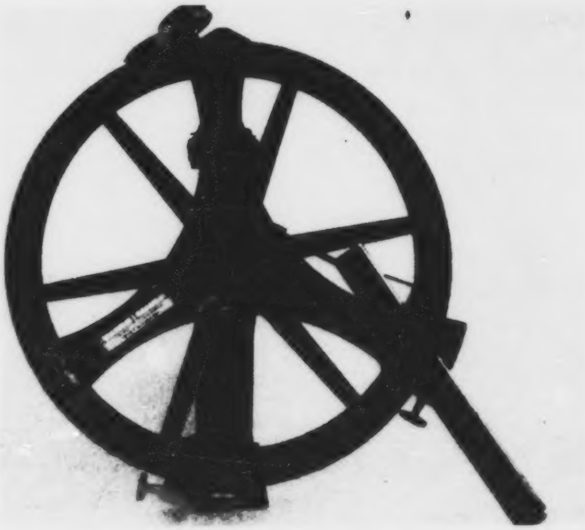

FIGURE 12
Sextant (undated) by Dolland of London.

During the same general period the Englishman Jesse Ramsden (1735-1800) became famous in another important branch of the instrument-making industry. He developed the first "dividing engine". Demand for his theodolites and other instruments became so great that he was impelled to devise a mechanical means of dividing the circle with precision. But it was not until 1775 that he produced a suitable working model. By the close of the 18th century the basic principles of instrument construction had been worked out and from that time forward it became more a matter of modifying instruments to meet special needs.

Ramsden, inspired by reports of an impending trigonometrical survey of Great Britain, took a long step forward toward the perfection of a portable, accurate transit theodolite. With the aid of a special lathe of his own contrivance Ramsden produced a hob for cutting the precision worm-wheel on a "dividing engine", as it came to be called. The latter machine consisted of a large, circular metal plate the circumference of which was very precisely marked off in degrees and half-degrees. The smaller circle of the instrument being constructed was placed in the centre of the machine. By the guidance of the marks on the circumference of the dividing engine, precise graduations of scale were then engraved, proportionately, on the smaller circle. This invention by Ramsden signalled the introduction in quantity of precision instruments designed for surveying work. Ramsden was awarded £615 by the Commissioners of Longitude for training men in the use of his device.

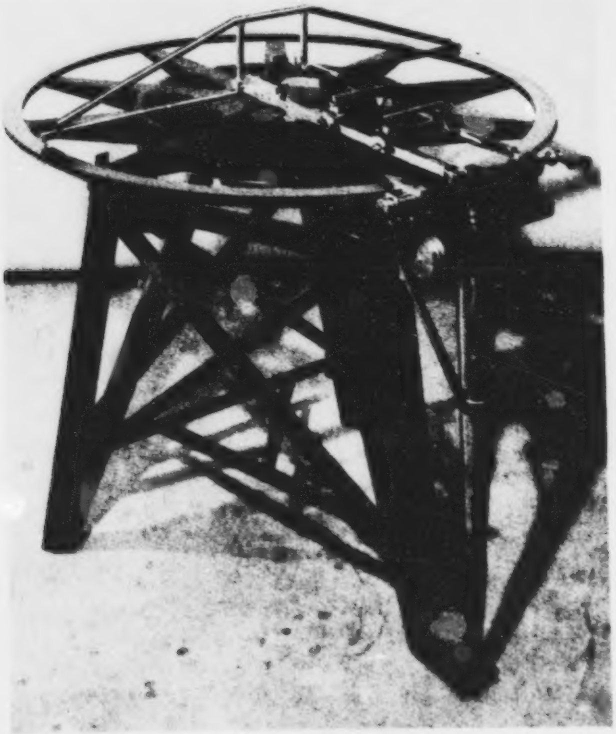

FIGURE 13
Ramsden dividing engine.

In the New World the art of graduation or calibration of instruments was further developed by a talented Philadelphian, William James Young, who built a "graduating engine" in the 1830s at a cost of $7,000 and many hours of exacting toil and tests by highly skilled workmen. This contrivance was a distinct improvement over the English apparatus in use in America up to that time. Another American instrument maker of importance during the same period was Richard Patten who described himself, with apparent justification, as the "only Manufacturer of Sextants and Quadrants in New York" (1813-1842) and who also claimed that all instruments of his making were "warranted, being divided on an engine after the Plan of Ramsdens."[7]

In 1826 William Simms in England invented the self-acting mechanism that made the dividing engine automatic in operation. The portable transit, designed especially for the use of land surveyors and civil engineers, was invented by W. J. Young in 1831 when he mounted a low-power telescope on standards over the dial of a surveyor's compass. In 1835 the first Solar Compass was made under Young's direction.[8]

In Canada, in February of 1791, John Collins, Deputy Surveyor General, advised the Land Committee of the colony that the government did not own any surveying instruments but that he and his deputy surveyors owned "good horizontal Theodolites". He listed his own instrument as being a product of Rowley. Six of these theodolites had been sent out from London in 1785 and were intended for surveyors at Gaspé, Chaleur Bay, St. Thomas, Detroit and Kingston. The sixth was retained for the son of John Collins. Four years later three more theodolites were acquired and an additional three instruments in 1791.

In 1794 a request was made to Governor Simcoe for a number of instruments for the use of the office of the Surveyor General of Upper Canada at Niagara. The list included a Gunter's chain, a theodolite, a "plain table", a perambulator, a pocket telescope, a circumferentor and a Hadley's sextant as well as compasses, spirit level, thermometers and barometers. In a letter from Elizabethtown dated June 22, 1814, deputy surveyor Robert McLean advised Surveyor General Ridout of Upper Canada that he had completed the construction of his own theodolite, a task commenced in 1812, as he could not purchase one that suited him. He found that its utility and accuracy exceeded his "utmost expectations". This theodolite may well have been the first such instrument built in what is now known as Ontario.

McLean also indicated that he was most anxious to obtain "a good magnet or loadstone" with the object of experimenting to determine longitude without reference to time or celestial observations. In asking that the Surveyor General try to supply such to him McLean expressed a profound truism, "You may perhaps consider me a visionary, and perhaps I am so, but important discoveries have been made by simple means, and sometimes by accident."[9]

Although the magnetic compass, as a land surveying instrument, was displaced in the course of time by the theodolite or transit in the interests of more precise measurements, it remained the mainstay of many land surveyors in Canada, particularly in the Atlantic provinces, for most of the 19th century. Its greatest usefulness was in original surveys on which accuracy was sacrificed to the need for speed and to the consideration of low cost. It was also useful in the resurvey of boundaries first laid out by reliance on the same instrument. One of its inherent weaknesses resulted from regional variations in magnetic declination. The need for checking the performance of compasses was widely recognized and laws were passed in many states of the American union, requiring each surveyor to test his compass periodically on some established meridian line.[10]

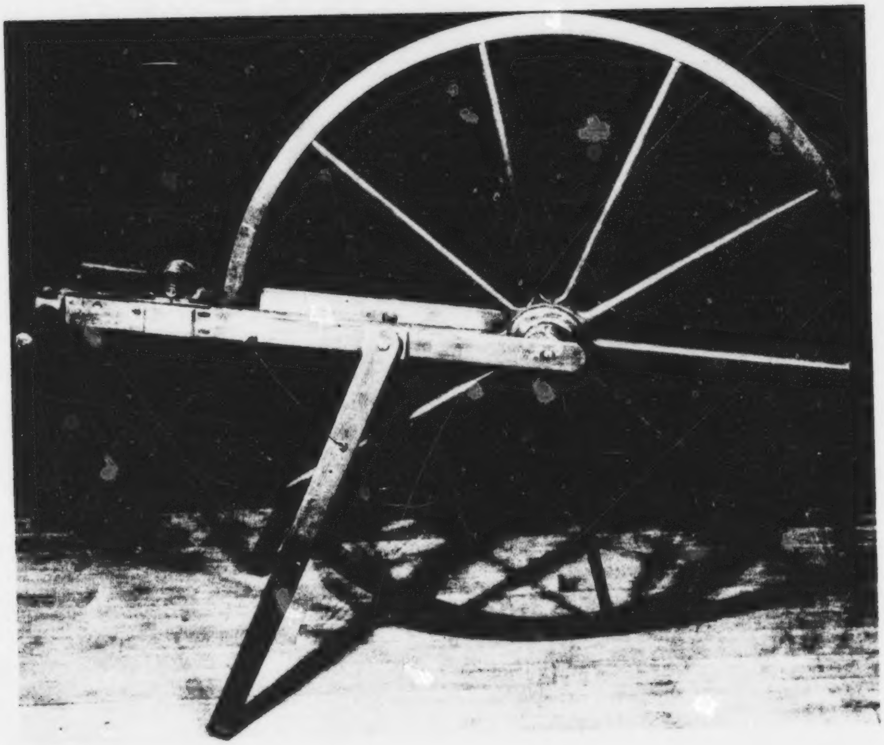

FIGURE 14. Odometer used by Sir William Logan.

For some years following Confederation there persisted among some surveyors and under certain conditions in this country the practice of roughly calculating distances by counting the number of paces, or number of wheel turns, required to cover same. A pedometer, a small instrument resembling a watch, could be worn on the person for the purpose of registering paces. A perambulator, attached to a wheel, served to record the number of wheel turns.

The historic surveyor's chain, less accurate in its functioning than the modern steel tape, was more easily damaged in the field and, when damaged, more difficult to repair. For historical review purposes two types of chains in common use should be kept in mind, namely, Surveyor's (or Gunter's) chain, and the Engineer's chain. Gunter's is 66 feet long and its use confined chiefly to land surveying on account of its simple relation to the acre and to the mile. The Engineer's chain was 100 feet long and divided into 100 links of one foot each. However, the link chain could not be used for highly refined measuring work. The 66-foot chain remains a definite measure of length, each of its 100 units being known as a link. Land surveyors, especially on township surveys in the West, generally preferred to use the link chain whereas in many modern surveying and engineering projects, such as highway and railway construction, a longer chain or tape, divided into feet, is preferred.

The use of steel tapes, because these are lighter, more compact and therefore more portable, produces savings in time and labor. Steel tapes also provide more accurate results in measurements made over rough ground, short of the use of special base-line equipment. Tapes, uniform in width and thickness, vary in length from 50 to 500 feet and are graduated in feet or links. In 1896 C. E. Guillaume discovered a nickel-steel alloy which was thereupon named "Invar". This substance had a very "low coefficient of thermal expansion" as scientists describe the response of metal to variations in temperature. When it was found possible to make long bands out of Invar the measurement of geodetic survey lines was revolutionized. Older forms of apparatus designed for the purpose became virtually obsolete.* The discovery of the new alloy was especially significant to Canadians carrying on basic or control measurements in this country where changes in temperature, sometimes both rapid and extensive, posed a problem through the expansion and contraction of instruments. In a 300-foot tape, for example, a drop from 120 degrees above zero to 20 degrees below zero, the total contraction would amount to 3 inches.

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*In 1883, Surveyor General Lindsay Russell reported, "The ordinary surveying chain was [being] replaced by a continuous steel band."

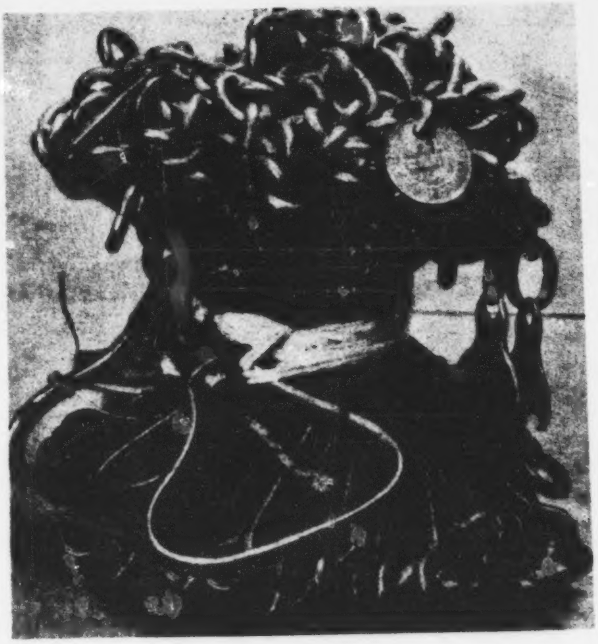


FIGURE 15
Gunter's chain.

The telescope, soon after its invention early in the 17th century, became one of the most important tools of the surveyor. By the employment of this instrument the properties of glass or lenses are used to obtain substantial magnification in the field of view of the telescope. The inclusion of cross hairs in this field of view and the mounting of the instrument on a circle were important steps forward in the practice of surveying. So far as most surveying work is concerned, light may be considered as travelling in a straight line, thus permitting the determination of directions in which the telescope is trained.[11] This is the basic principle of the transit theodolite and related instruments. The accuracy of the telescope is limited by the horizontal and vertical refraction of light. In precise surveying it is necessary to do angle work at night when refraction is at a minimum.

In the 17th century attachments for reading scales, for levelling, and for telescopic sighting gradually came into use in astronomy. The adaptation of these devices to surveying instruments was even slower.

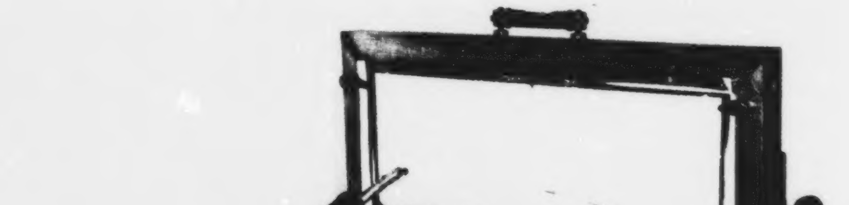


FIGURE 16. Photo-alidade, used for measuring horizontal and vertical angles.

The instrument most commonly used by surveyors in the field is known alternatively as a transit or a theodolite. The perfectionist in linguistics would use the term "transit theodolite". In England, however, the term "theodolite" is favored in everyday parlance whereas "transit" is preferred in Canada and the United States. In any event a theodolite of the transit type is meant, the instrument being one on which a telescope can be turned or transited through a complete or nearly complete revolution about a horizontal axis attached to the telescope. With this instrument it becomes possible to project alignments, carry out triangulation operations, observe or lay out angles in horizontal or vertical planes, to estimate distances, establish grades, run levels and erect perpendiculars. Essentially the transit theodolite consists of three principal components: the levelling base, the graduated horizontal plate, and the alidade. The latter is essentially a telescope mounted on an upright standard and attached to a metal base used as a straight edge. The telescope can be rotated vertically and an arc permits reading of information from attached vernier scales.

In Canada, however, especially on government land surveys, English-made transits were more frequently used than those of American make. The Dominion land surveyor's Cooke instrument, manufactured by T. Cooke and Sons, Limited, was almost standard equipment for the field in Surveyor General Deville's organization. For the period between 1903 and 1910 the transits and other instruments manufactured by E. R. Watts and Son Limited of London, England were much favored by the Surveyor General. In fact, it was on Deville's suggestion that the Watts firm opened a branch office in Winnipeg about 1908. But in subsequent years departmental purchases from that firm dropped close to the vanishing point. The reasons for this decline were never clearly stated but much documentary evidence exists to justify the conclusion that the fall of the Watts firm from grace in Ottawa was due not so much to defects in their line of instruments as to influences of a personal nature affecting choices of equipment made by Deville.[12]

T. Cooke and Sons Limited, founded in 1840, and Troughton and Simms, both of London, England, were firms of prominence and excellent reputation in the instrument-making field. About 1922 these two rival companies merged to form Cooke, Troughton and Simms. In the mid-twenties of the present century there was a flurry of inventive activity in the world of scientific instruments, followed by the appearance of several new types of transits. In 1926 Cooke, Troughton and Simms produced the now well-known Tavistock theodolite, fitted with a glass circle, and by means of which optically meaned readings could be made to one second of accuracy. About the same time E. R. Watts and Son (Hilger and Watts) introduced the Microptic theodolite in several models, under licence from Zeiss to use their system. On the continent of Europe there were significant new developments also. Two types of improved transits appeared on the market. One was produced by Wild Heerbrugg Limited, Switzerland, the other by the Carl Zeiss firm of Jena, Germany. The introduction of the Wild and Zeiss transits provided the surveyor with brand new weapons with which to attack his field problems. No heavier than light mountain transits, their circles could be read to one second, a degree of exactness formerly associated only with large, heavy geodetic instruments.[13]

The story of the growth of the Wild firm is especially interesting. The principles governing the design of the Wild type of transit were conceived by Heinrich Wild (1877-1951) while he was serving with the Swiss Federal Survey. In 1908 he became associated with Carl Zeiss and in the following year devised a new, lighter and more

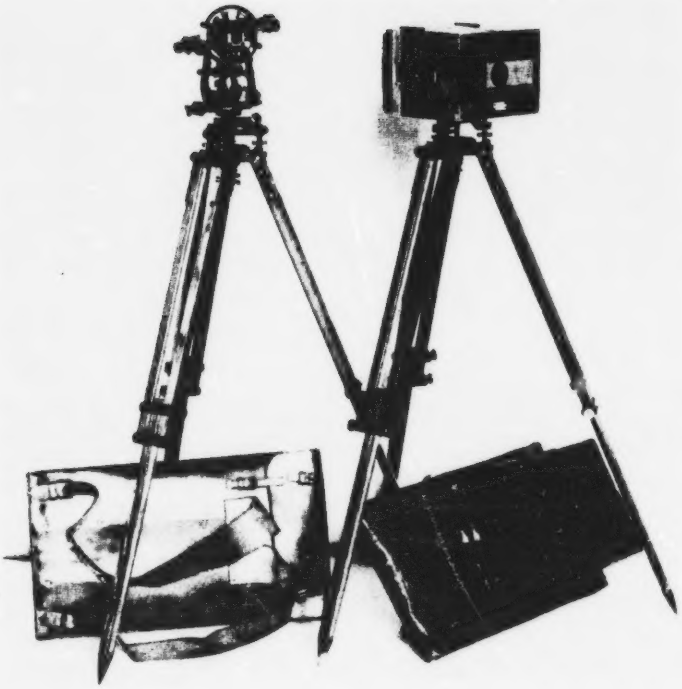


FIGURE 17
Mountain transit and camera.

stable type of tripod. It was this association of Wild with Zeiss that led to the appearance of the first Wild transit. This Zeiss-made instrument reached the market just prior to the outbreak of the First World War but was little known outside Germany until 1920. In the following year Wild, having established his own factory at Heerbrugg, Switzerland, began making the second model in the series of Wild transits.[14]

The Zeiss and Wild transits differed considerably in appearance from the then existing instruments in that category, as well as in the method of fineness of reading the horizontal and vertical circles. In the improved transits both circles could be read to the nearest second in a small micrometer microscope, placed slightly to one side of the eye-piece end of the telescope. The new Zeiss transit weighed only 7½ lb. and the Wild, 9½ lb., compared to the 13¼ lb. Dominion land surveyor's Cooke transit. The cost of the new instruments, laid down in Ottawa, was about $475 each. Although special efforts were directed to reducing weight, this advantage was achieved without lessening the strength or basic stability of the instrument.[15]

In Canada, John Leslie Rannie (1886-1954) Dominion topographical surveyor, of the Geodetic Survey of Canada became known as "the apostle of the optical theodolite". When Wild's new theodolite design first appeared on the market, Rannie supported it enthusiastically. At first only the T2 type of Wild transit was available and Rannie realized immediately that the small aperture of the telescope was the main reason why

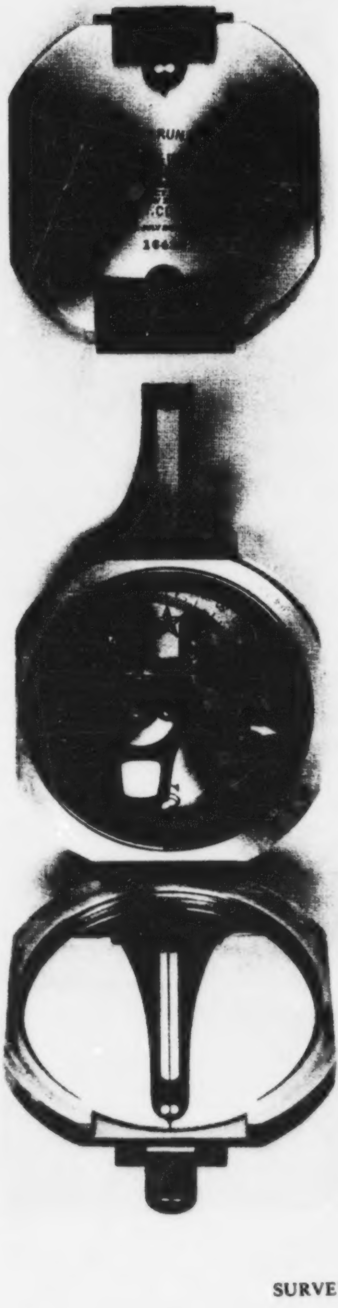


FIGURE 18
Brunton's pocket transit (compass), actual size.
Above — closed; below — opened.

this lightweight transit could not replace the cumbersome first-order theodolites for very precise work. It was partly as a result of Rannie's suggestions that the T3 type was designed, incorporating a larger telescope. This precision theodolite for first-order triangulation came on the market in 1925. Other improvements were made later to this instrument as a result of investigations made by Rannie and his able co-worker W. Melbern Dennis. Curiously, the T1 model of theodolite did not come on the market until six years later.

Dr. Wild died on Christmas Eve, 1951. In his working lifetime he had played a critically important part in the development of three major precision instrument companies, Zeiss, Wild and Kern, a record unlikely ever to be equalled in this specialized field.

Some outstanding instrument-making firms in the United States were Young and Sons of Philadelphia, taken over in 1918 by Keuffel and Esser Company of Hoboken, New Jersey, and W. and L. E. Gurley of Troy, New York. W. F. Stanley and Company Limited of London, in addition to English firms already mentioned, was prominent in the instrument-making field in the period presently under review. At the time no firm in Canada was engaged in manufacturing transits but some well-known businesses in this country imported such instruments for surveyors, including James Foster of Toronto, Consolidated Optical Company Limited of the same city, and Hearn and Harrison of Montreal. With the approach of the Second World War experimental progress in the realm of survey instruments came to a temporary halt. But by then the modern transit had become firmly established as the paramount ally of all land surveyors. Its light weight, sturdiness, easy and rapid manipulation, convenience and simplicity combined to create an appeal unmatched by any other single item of surveying equipment.

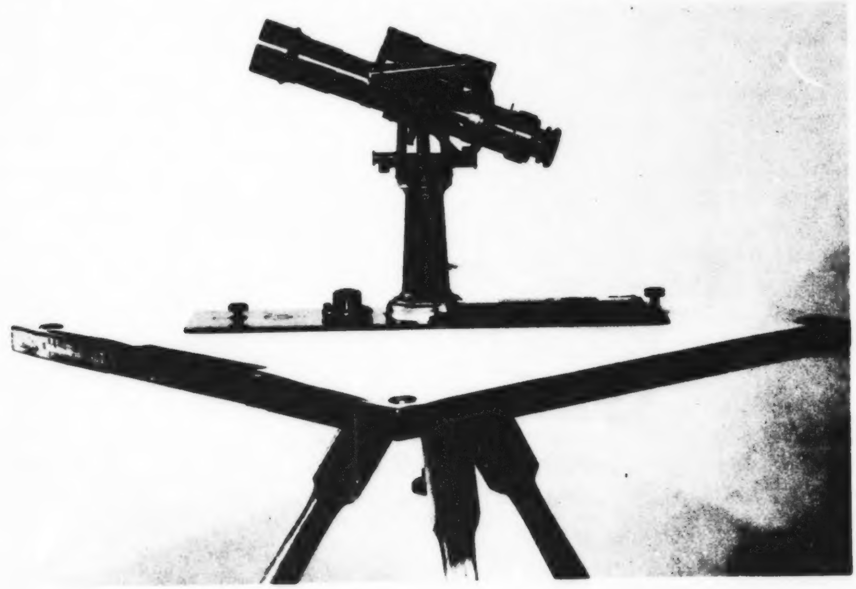


FIGURE 19. Boyd alidade and Johnston traverse plane table.

Levels of various types comprise another large and important area of instrumentation in the practice of surveying. Levels are employed to provide differences of elevation either directly, as in the case of the surveyor's level, or by utilizing differences in atmospheric pressures as in the case of the barometer or boiling point thermometer (hypsometer) or by slope measurements as in the case of clinometers and other types of vertical angulation, or where the distance in the stadia, slope or horizontal is determined.

In the earliest stages of the development of the level the plumb bob was enclosed in a wooden box to protect it from disturbance by wind. Also more accurate sights were constructed using the thread of a silkworm. Two important additional steps were required in order to form a basis for subsequent refinements of the level, namely the provision of a bubble tube and a telescopic sight. The former invention is attributed to two citizens of France, Thevenot and Chapotot, in the 1660s. Henry Wilson, in *Surveying Improved*, published in 1731, describes this instrument as a level tube filled with a liquid with open sights of equal height at each end and with proper screws for adjustment purposes. The use of the telescopic sight in this connection is attributed to Gascoign who, it is claimed, placed spider webs in the focus of the telescope attached to his surveying instruments as early as 1640. Picard, another French surveyor of distinction, applied the telescope to angle measuring and to levelling instruments in 1669. The wye level is said to have originated with Jonathan Sissons of London in 1740. In levelling operations work generally begins at a permanently fixed point whose elevation above some datum plane is known. Such a point is called a bench mark.

Barometers, including aneroids, and hypsometers are utilized for direct measurement of elevations above some standard such as mean sea level. Aneroid barometers (altimeters) are also used in aeroplanes for determination of the height at which they are flying and in the case of air survey work, recording the altitude at which photographic plates are exposed. Following the Second World War the statoscope, a new aviation instrument, came into wide use. By this device it became possible in flight to measure precisely differences in elevation between successive plate exposures. Generally barometers are used for topographical and reconnaissance work on a small scale, when precision in altitude determination is not essential. The hypsometer, a relatively coarse instrument, used mainly in exploratory survey work, has been displaced by the aneroid which has equal portability and accuracy, and dispenses with the need to boil water.

There are two types of surveyor's level in general use, the dumpy and the wye level. The functioning of all levels depends in essence on an ordinary level tube containing an air or vapour bubble in a suitable liquid. Under the influence of gravity the bubble will always rise to the highest part of the tube and come to rest, so that a plane, tangent to the inner surface of the tube at the highest point of the bubble, defines a horizontal plane. The basic difference between the dumpy and wye levels is that in the former the telescope and bubble tube are rigidly attached to the instrument, whereas in the wye these are independent of other parts of the instrument and may be lifted from their supports and turned end to end.

In this chapter consideration has been given to the progressive development from earliest times of instruments useful to the surveyor and mapper. The transformation over the centuries of primitive measuring tools into precision equipment has been gradual for the most part. But even the most impressive of the periods of advance prior to the Second World War was overshadowed by what took place in this field after that conflict. By combining photographic and electronic equipment with various types of

FIGURE 20. Tellurometer in use.

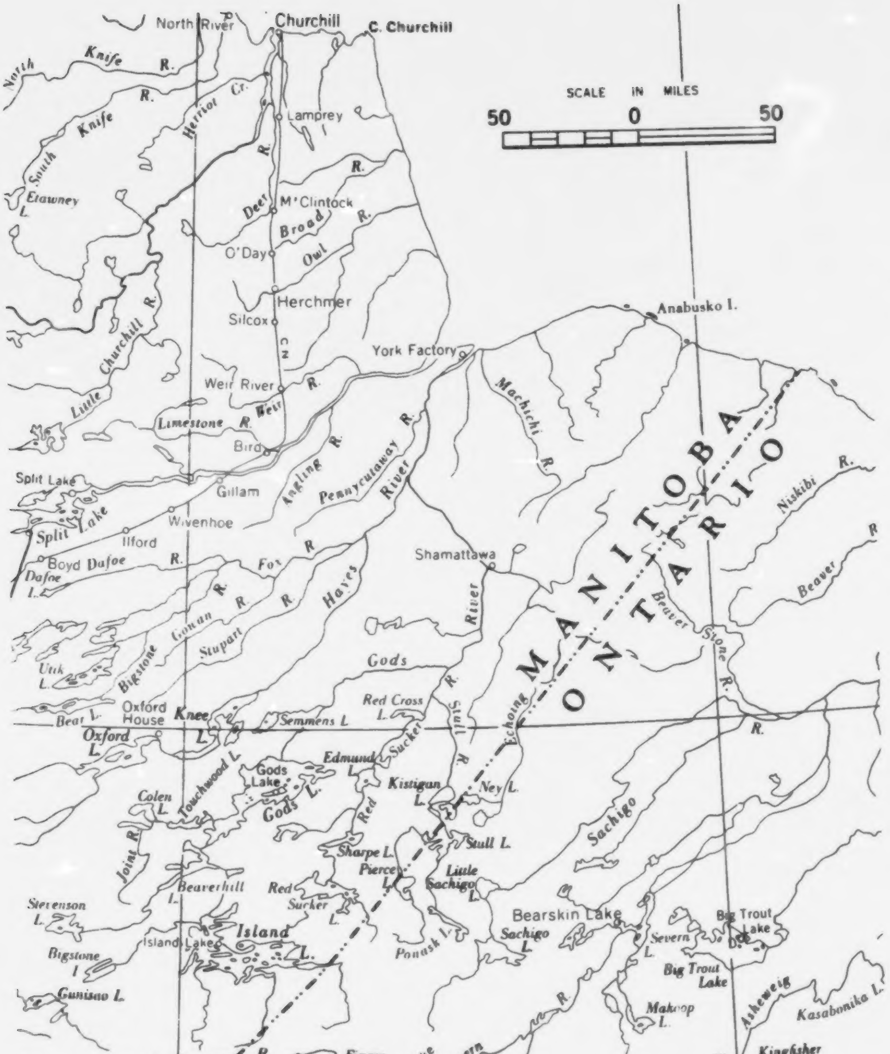
existing instrumentation, along with rapid and far-reaching developments in aviation, giant forward strides resulted in the surveying and mapping, efficiently and swiftly, of large geographical areas. Tellurometers, airborne profile recorders, the use of radar in electronic distance measurement, refinements in the airborne survey camera as well as surveys made from satellites in outer space orbits, are only some of the phenomenal new devices and systems that have brought about a profoundly absorbing revolution in the production of new surveying instruments and of special techniques involved in their uses.

3

THE ONTARIO-MANITOBA BOUNDARY: COMPLETION SURVEYS

In terms of historical background and physical achievement the establishment of the Ontario-Manitoba boundary on the ground, following its definition in law, provides one of the liveliest episodes in the annals of Canadian surveying. Indeed the narrowness of the closure on the Hudson Bay terminal point of the boundary, across 168 miles of largely unmapped wilderness, remains as a remarkable accomplishment in land surveys generally. Highlights of the extended and, at times, violent argument over the location of the border have been described in a chapter of Volume Two of this work, along with an account of the initial (Stewart-Saunders) survey, completed in 1897 and covering 58 miles.

No additional boundary surveys were made along the Ontario-Manitoba line until after the First World War but in the interval some significant statutory steps were taken, paving the way for new developments in the field. In 1912 Parliament at Ottawa passed two boundary extension acts, one applying to Manitoba (2 Geo. V, ch. 32), the other to Ontario (2 Geo. V, ch. 40). Under this legislation and with the consent of the two provinces concerned, large areas of Dominion lands were added to their respective territories. The boundary line separating these vast additions was defined as a due north extension of the existing boundary up to the 12th base line of the Dominion Lands Survey System, proceeding in a straight line to the most easterly point of Island Lake, from thence in a straight line to the intersection of the 89th meridian with the southern coast of Hudson Bay. Though defined definitely enough on paper, nothing existed in the form of markings on the ground, up to the end of the First World War, to indicate the location of this 550-mile-long border extension. Nor did there appear to be any pressing need for its physical demarcation until a post-war upsurge in mining activity took place in the vicinity of the boundary to the east of Lake Winnipeg.


North River
Churchill
C. Churchill
North Knife R.
South Knife R.
Herriot Cr.
Lamprey
SCALE IN MILES
50
0
50
Etawney L.
Deer R.
M'Clintock
Broad R.
O'Day
Owl R.
Herchmer
Silcox
Little Churchill R.
C N
Anabusko I.
York Factory
Weir River
Weir R.
Limestone R.
Bird
Machichi R.
MANITOBA
ONTARIO
Niskibi R.
Split Lake
Split Lake
Gillam
Angling R.
Pennycutaway R.
River
Wivenhoe
Ilford
Boyd Dafoe
Dafoe R.
Dafoe L.
Fox R.
Shamattawa
Beaver R.
Beaver Stone R.
Gowan R.
Stupart R.
Hayes
Utik L.
Bigstone
Gods
River
Red Cross L.
Sucker R.
Stull R.
Echoing
Oxford House
Knee L.
Semmens L.
Bear L.
Oxford L.
R.
Touchwood L.
Gods Lake
Gods L.
Edmund L.
Kistigan L.
Ney L.
Colen L.
Red
Sachigo
Joint R.
Sharpe L.
Stull L.
Pierce L.
Little Sachigo L.
Beaverhill L.
Red Sucker L.
Stevenson L.
Bearskin Lake
Big Trout Lake
Island
Island Lake
L.
Sachigo L.
Severn L.
Ponask L.
Bigstone L.
Big Trout Lake
Gunisao L.
Makoop L.
Asheweig R.
Kasabonika L.
Cobham R.
Finger L.
Sandy Lake
Severn
Sandy L.
Big Beaver House
Kingfisher Lake
Round Lake
North Caribou Lake
Wunnummin Lake
McPhail R.
Charron L.
Favourable Lake
Deer Lake
Atikup
Deer L.
North Spirit L.
Assinika R.
Pipestone R.
Pineimuta R.
McInnes L.
Flanagan
Little Grand Rapids
Fishing
Stout L.
MacDowell L.
Totogan L.
R.
Poplar Hill
Family L.
River
Barton L.
Throat R.
Cat Lake
Williams Lake
Otoskwin
Cairns L.
Pikangikum
Nungesser L.
Casummit Lake
Cat
Central Patricia
Pickle Crow

MAP 1. Part of Ontario-Manitoba boundary, including portion from Island Lake to Hudson Bay.

Early in 1921 interprovincial boundary commissioners were appointed by the governments at Ottawa and Toronto respectively, Manitoba having declined to join in the survey project or to pay any part of its cost. Surveyor General E. Deville acted for Canada, and Director of Surveys Louis Valentine Rorke (1866-1943) for Ontario, each jurisdiction undertaking to absorb one-half of the total expenditure involved in the survey.[1] Incidentally, Rorke, a graduate of the School of Practical Science, University of Toronto, served his articles with Elihu Stewart who had been associated with Saunders on the initial survey of the boundary. By 1891 Rorke was a Dominion land surveyor and an Ontario land surveyor. He became Director of Surveys, Ontario, in 1917 and eleven years later, Surveyor General of the province, a position he held until his retirement in 1936. He served as president of the Ontario Land Surveyors Association in 1925.

The first step was to select a survey party chief. It was considered essential that the person to be placed in charge of operations on the ground should be qualified as a Dominion and provincial land surveyor. John Wesley Pierce (1885-1949) of Peterborough was named chief of party. Appointed with him as his assistants were Robert Douglas Davidson (1892-1960) and John Carroll (1888-   ) of Ottawa. The name of J. W. Pierce is an outstanding one in Canadian surveying and mapping. His high reputation is closely linked to the Ontario-Manitoba boundary surveys between 1921

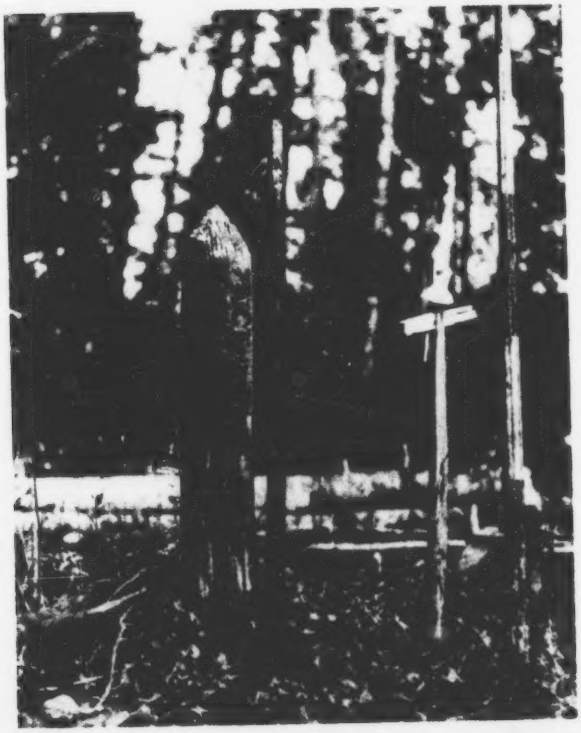


FIGURE 21
Cedar post (1897) Monument 1. Initial point of Ontario-Manitoba boundary, marking North West Angle, Lake of the Woods.

and 1937, and to a point within 168 miles of Hudson Bay. A deep disappointment to him was his inability, due to ill-health, to assume charge of the final leg of this important survey, a section undertaken in 1947. His regrets were mitigated by the participation of his son John in this concluding survey operation. The ultimate highly successful closure with the shore of the Bay on the point established there by C. H. Ney in 1930, was due in large measure to Pierce's careful work and sound survey knowledge and mastery of its techniques. Born in Eaton Corner, Quebec, Pierce senior graduated from the University of Toronto in 1906 and three years later was commissioned both as a Dominion land surveyor and an Ontario land surveyor. His early practical training was with Ontario land surveyors J. W. Fitzgerald of Peterborough and Alexander Niven of Haliburton. In 1920 he was commissioned a Manitoba land surveyor, just one year after he had joined the federal Topographical Surveys Branch, Department of the Interior. From 1932 to 1949 he was engaged in private practice in Peterborough and became an ardent student of the history of that area. His son, John Gourlay Pierce, an Ontario land surveyor of distinction, has carried on in the fine professional tradition of the father, as senior member of the firm of Pierce and Pierce of that city.

FIGURE 22. J. W. Pierce.

By 1929 Manitoba became a party to the interprovincial boundary survey and the continuance of J. W. Pierce as chief of party in the field was concurred in by that province. In 1932 the federal government transferred to Manitoba the control of that province's natural resources, and Pierce continued as field chief under the direction and authority of the Ontario and Manitoba governments. From 1924 he was closely associated with aerial mapping operations in Canada. Pierce trained and directed Ontario land survey parties which helped to map Muskoka and Lake Nipissing districts. This distinguished Canadian served as president of the Association of Dominion Land Surveyors in 1928 and of the Association of Ontario Land Surveyors in 1932.

Instructions authorizing the survey of what became known as the meridian section of the boundary, covering 180 miles due north of the Winnipeg River as far as the 12th base line, roughly parallel to the eastern coast of Lake Winnipeg, were issued on March 7, 1921. The need to forward supplies and equipment to bases in the field for use during the ensuing season was early realized and some ten tons of freight of this sort were hauled on snow-covered roads by horses, and by dog teams over trails to Gold Lake and Wallace Lake in mid-March. During afternoons snow became so soft that dogs could not work and so packing had to be done in early forenoons and late evenings while frost conditions prevailed.[2]

A survey party of twenty-four was engaged in Winnipeg and on June 2 proceeded by train to Pointe du Bois, Manitoba. In addition to the party chief and his two surveyor assistants the task force consisted of a chainman, instrument man, leveller, mounder, picketman, three rodmen, seven axemen, a head packer and three canoeman-packers as well as two cooks. The duties of the party members were interchanged a good deal as special conditions were encountered in the course of the survey.

Surveys in the field commenced on June 6, starting at the monument on the south side of Winnipeg River that marked the terminal point of the 1897 boundary survey. The marker was in such poor condition that it had to be replaced by a standard concrete monument later on. The original boundary line, although visible, had been so overgrown that it was necessary to clear it for some distance back from the river to obtain a direction by which the line could be produced northward.

The arduous physical labor involved in this type of field work demanded men of a type no longer readily available. They had to be adept in the use of the canoe and tump line; skilled in the use of an axe; willing to separate themselves from hearth and home for an entire season; content to live on summer provisions cached from the previous winter; and preferably possessed of survey experience. Natives of the area, with their more intimate knowledge of the region to be surveyed, were most suited to these requirements but seldom could be induced to remain on the project for the full season.

R. D. Davidson, senior assistant to Pierce, was responsible for line production, azimuth and magnetic observations, and triangulation work. John Carroll had responsibility for precise chaining operations, marking of monuments and the recording of topographical data. Later in these boundary surveys Richard Dore carried on with the supervision of chaining. J. W. Pierce wrote later in considerable detail on problems confronted during this phase of the work:

"The effect of changes in temperature results in appreciable differences in the length of any long course, when measured by a steel chain. The Invar tape has been designed to remedy this but it will not stand the usage to which the chain is ordinarily subjected in bush or northern surveys. On ordinary surveys it is now customary to determine the temperature with a pocket thermometer and a correction is applied to the measurement. As the chain is seldom of a constant temperature throughout, and is continually passing through the sun, over rocks, in the shade, or through water, the correction becomes a most uncertain quantity. The method used through the boundary survey was to determine the temperature of the chain at each successive measurement and to calculate the correction from the coefficient of steel tapes . . . Ordinary thermometers were used for this purpose the first season but it was found that the temperature corrections were not in keeping with the general accuracy of the other details of the chaining and that some different form of thermometer that would record more closely the temperature of the chain would be required.

"On Mr. Way of the Surveys Laboratory [Ottawa] being approached, he suggested a modification of the type used by the Geodetic Survey. This consisted of a trough thermometer with a broad flat bulb, so arranged that the thermometer was clipped on to the chain and the . . . bulb held in intimate contact with the chain . . . With the discontinuance of the use of the old link chain and its ever changing length, chains now in general use are not subject to appreciable variation between the absolute length and that of the official standard of measure. Where, however, the course is of great length, any discrepancy is multiplied with each measurement and is cumulative in effect. In order to counteract this result, a chain of the same size and weight, whose length had previously been determined at Ottawa, was taken to the field as a standard of measure. By comparing this at intervals with the field chain, a correction, that was found to alter somewhat through the season, was deduced and applied to all measurements."[3]

The means of transport in the field consisted of four freight canoes, three smaller canoes and an outboard motor. The summer season was chosen for field work in preference to the winter for reasons peculiar to Canada. The summer season is customarily a month longer, the amount of equipment needed is much less in warm weather. Sand, gravel, and stone for monuments and mounds are, as a rule, readily available in summer.

October 14, 1921, was the last day in the field before the survey party returned to Winnipeg. During the season a stadia tie line connection was made between the line where it crossed Garner Lake and a marked post in a stone mound on an island near the south end of Beresford Lake. This monument had been erected in 1919 by the Dominion land surveyor Bruce W. Waugh. The most serious accident that happened during the season occurred when a tree near the survey line was dislodged by wind and fell suddenly on the surveyor in charge. He did not recover consciousness for twenty hours. When he reached the city three weeks later it was discovered that his collar bone had been fractured and two ribs splintered. So effective, however, had been the rude but prompt attention accorded the patient in the field that no additional medical treatment was required.[4]

Unused provisions of flour, meat, sugar, tobacco and a full line of groceries were cached in a cabin built for the purpose at the north end of Carroll Lake and left under guard for use in the following field season. Tangible results of 1921 operations included the surveying of a total of 69 miles of boundary line running from Winnipeg River to headwaters of Bloodvein River; the erection of 752 permanent monuments and a traverse of 385 miles of shoreline of water areas.

For the 1922 field season some ten tons of provisions and of outfitting were forwarded in mid-winter to the mouth of the Berens River by way of frozen Lake Winnipeg. Continual winds commonly pack snow so firmly that the surface of lake ice becomes almost impassable to traffic. Accordingly a snow plough was propelled by horses operating behind it. The plough was closely trailed by the freighting teams. As a rule the laboriously opened roadway was completely filled in within a half an hour after passage of the loads. Near the end of February, R. D. Davidson, assisted by three men and using a dog team, reached Little Grand Rapids, slightly north of 52 degrees north latitude, on his probe of investigation. All this advance organization and exploration was designed to permit the expenditure on effective survey tasks of every hour of working time available during the short summer season. It was necessary, in fact, to maintain progress at the rate of at least one mile per day every working day, regardless

FIGURE 23. J. W. Pierce's survey party, Berens River, autumn of 1922.

of weather, in order to reach the 12th base line by the latest date in October that would permit return to civilization by open water.

Arrangements were made with the Canadian Air Force for their cooperation during the 1922 season so that the line and the areas adjoining it would be photographed from the air and so that mail might be delivered occasionally to field camps. It was shortly after completion of the evening meal in camp on July 3, 1922, at Clayton Lake, Manitoba, that a hydroplane was heard and seen approaching from the south. Dense columns of smoke were produced at the camp site to attract the pilot's attention. The plane landed on the nearby lake carrying Controller of Surveys A. M. Narraway of Ottawa and a load of mail on board. Narraway remained with the survey party for four days.

The 12th base line was reached on October 6. Members of the survey returned to Selkirk and were discharged there on October 23. The 111 miles of boundary line surveyed during the 1922 season, added to the 69 miles of the previous season, brought the total mileage surveyed to 180. This total, of course, was in addition to the initial 58 miles surveyed in 1897 by Stewart and Saunders. A total of 86 monuments was erected in the 1922 season and more than 100 magnetic and astronomic observations made.

The third leg of the resumed surveys of the boundary was not undertaken until the field season of 1929. The program consisted of surveying a trial line from the 12th base line to Island Lake. J. W. Pierce was again in charge. The direction of this line depended upon a precise astronomic observation at the most easterly point of the lake. By this time, in addition to Surveyor General Rorke for Ontario, the commissioners for this boundary survey were G. A. Warrington for Manitoba and Surveyor General Frederic Hatheway Peters for Canada. In view of the impending transfer to Manitoba of its natural resources the government of that province had decided to join the Dominion and Ontario in authorizing the boundary line survey.

On June 4, 1929, J. W. Pierce and Cecil Herman 'Marsh' Ney (1889-   ) left Selkirk on the first boat of the season bound for Norway House at the north end of Lake Winnipeg and a point slightly north of 54 degrees north latitude. Ney, after leaving Pierce to proceed separately, reached Island Lake on June 11 in a Royal Canadian Air Force Vickers Viking plane.

FIGURE 24. Boundary surveyors, Palsen River, 1929.

Ney, born at Bradford, north of Toronto, received his early education in Aurora, graduating in civil engineering from the University of Toronto in 1916. At university, where L. B. Stewart was one of his professors, Ney specialized in geodesy and astronomy because of a natural flair for precision measurements. In summer seasons, between university terms, he went on federal survey parties as an articled student, serving with Dominion land surveyors Wilbert Henry Norrish and Guy Houghton Blanchet (1884-1966) in Saskatchewan and Manitoba respectively. Following his graduation from university Ney enlisted in the Royal Flying Corps and went overseas. Within five days of his demobilization in 1919 Ney was on staff with the Geodetic Survey of Canada. In 1946 he was awarded the Order of the British Empire (Civil Division).

FIGURE 25. C. H. "Marsh" Ney.

Ney's own account of his procedure in establishing Point "A" at Island Lake is of special interest. After carefully making a trial selection of the point he built a concrete pier on a rocky outcrop about 300 feet away as a base for his astronomic telescope.

"A value of the longitude was made on each of three nights, taking time sets of about 12 or 14 stars observed both direct and reversed by means of the travelling transit micrometer. Radio time signals for Greenwich time were received . . . from the Washington Naval Observatory, Arlington, using the vernier clock system of reception . . . The latitude was determined by Talcott's method, taking pairs of stars transitting north and south of the zenith . . ."[5] The observation pier was connected to a post planted at Point "A" the target at which Pierce, nearly 90 miles away, was to aim.

Pierce had a much less comfortable and expeditious journey than Ney from Lake Winnipeg to Island Lake. It took him 17 days to cover about 120 miles, made difficult by 44 portages. It was a route which, up to that time, had been travelled only by Indians. The survey from just south of Elliot Lake began on June 26. Transportation along this section of the line was aided by reliance on an air map of the district, a rarity in those days. As a result very little exploration for routes was required and the movement of men and materials could be planned well in advance of the event. On September 6, 1929, the trial survey line across 87½ miles closed within 5.1 feet of Ney's post at Point "A".[6]

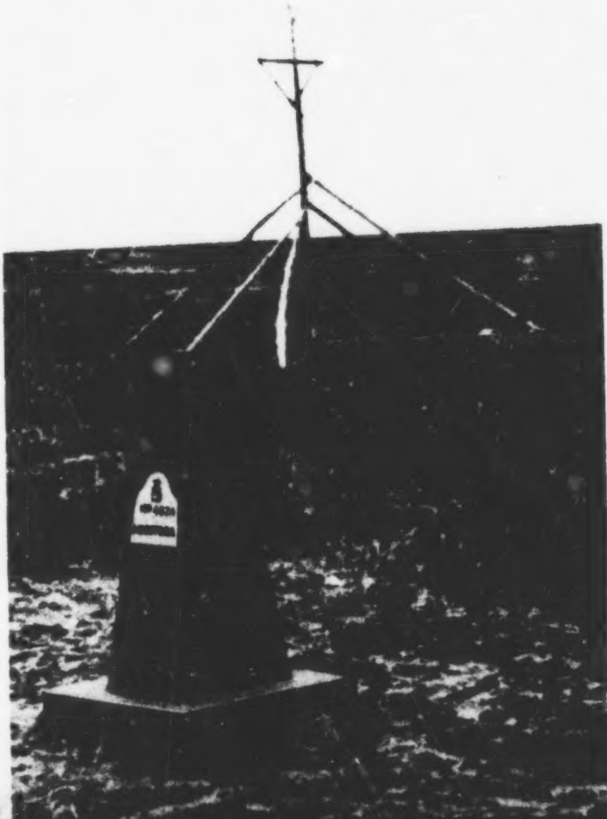


FIGURE 26
Boundary monument at Hudson Bay terminus; 1948 trial line with wooden target marking Ney's 1930 monument.

Chief of party Pierce has provided an illuminating comment on the survey work of that season:

"After computations we found that Island Lake was about 13 miles north of where it was shown on the map . . . and as a result of that error the area of Manitoba was 3,000 to 4,000 square miles less than shown on maps and the province of Ontario was correspondingly greater . . . Very soon there were [newspaper] headlines about "Ontario steals three or four thousand square miles from Manitoba" . . . The premier of Manitoba wanted to know what it was all about. When I came into his office the Surveyor General left the explanation to me. I was worried about what I would say, but after a little consideration it appeared that this was one of the finest examples of the need of accurate maps in Canada. . . ."[7]

As a preliminary step in the surveying of the Ontario-Manitoba boundary line from Island Lake to Hudson Bay, the last leg of the project, it was necessary first to determine the terminal point of survey on the southern shore of the Bay. This involved the establishment of two intermediate points along the proposed line of survey. Ney began his search by air for the first intermediate point on June 16, 1930. With the pilot, J. C. Uhlman, accompanied by an air mechanic and with Ney acting as navigator, the plane ventured over the unmapped territory of northeastern Manitoba. The first intermediate point was established near Black Duck Lake and the second, in mid-July, was established just north of Sturgeon Lake, Ontario.

To reach his destination on Hudson Bay in the absence of air transportation, Ney canoed down Nelson River to Port Nelson where he was storm-bound for several days. He did not reach York Factory until August 1. Ney has recounted that "in trying to make an entrance to York Factory we became stranded in the mud flats, three or four miles from shore. Not being able to go on for another 8 or 10 hours [waiting for the incoming tide] we set up our cots and had a good sleep on the bottom of Hudson Bay . . ."[8]

On August 2, 1930, very early in the morning, a start was made in two canoes on a hazardous 160-mile trip down the coast. Five days later it was estimated that the objective, the 89th meridian of west longitude, had been reached. Ney reported "we tried again that night and a preliminary observation showed us that we were one mile from the boundary terminal position." Difficulties of such a trip impelled Ney to comment that "travel on the west coast of Hudson Bay is a strenuous undertaking even in good weather . . . Due to the low elevation of the immediate coast, it is often impossible in hazy weather to see the shore at this distance. Consequently when travelling with outboard motors it is advisable to run entirely on compass bearings. A day's journey . . . cannot be ended at will. Until the tide comes in about eleven and a half hours from the time of high water, the traveller must stick to his ship in fair weather or foul. It is for this reason that travel in small craft is not considered extremely safe along this coast. Should a sudden storm blow up, so bad as to threaten disaster, a landing can usually be made through the surf, although boats and cargoes are generally sacrificed."[9]

On landing Ney made numerous observations for latitude and longitude and a concrete monument was built to mark the meridian intersection with the shore of the Bay. As an aid in locating the monument a 15-foot beacon was erected. The position of the monument was calculated to be 56°50′26″.73 latitude and 88°59′59″.10 longitude. The final legally-established terminal, based on a survey of the trial line 18 years later, was only 15.8 feet away, so close that the commissioners recommended that the line be adopted as the true boundary.

FIGURE 27. Ney's party stranded on Hudson Bay flats awaiting tide, 1930.

Work in 1930 on the leg to Island Lake, commenced the year before, was confined to final monumenting and levelling of the trial line, it having been accepted as the true boundary. A total of 76 intervisible monuments were erected in this connection. In 1932 there was a retracement survey of the 1897 line, carried out by J. W. Pierce (Canada), L. V. Rorke (Ontario) and Samuel Ebenezer McColl (Manitoba). The original line had been clearly enough marked to permit the restoration of all but two of the 82 monuments placed along its 58 miles, thirty-five years previously. Survey work on the most northerly leg of the boundary was not resumed until the 1937 field season, carrying the line from Island Lake to Echoing River, a distance of 114 miles. Pierce was accompanied on this stage of the work by Manitoba (and Dominion) land surveyor Edward Gauer, functioning as first assistant.

In the eight years following the survey of the Ontario-Manitoba boundary line to Island Lake the use of planes for the transport of men and supplies on field surveys had greatly increased. The decision to use aircraft on the 1937 survey was based on the strong recommendation of the commissioner S. E. McColl, at the time Director of

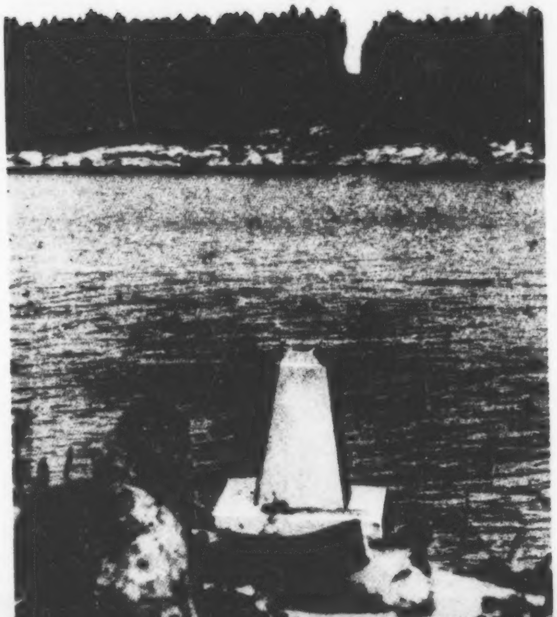


FIGURE 28
Monument 82, on south bank of Winnipeg River, erected at point of beginning of 1932 retracement survey.

Surveys for Manitoba. Under his direction base and meridian lines in the Island Lake and Gods Lake regions had been surveyed in winter. Through the employment of planes the camps had been made more comfortable and diets more normal.

The initial group of field-party members was flown to Island Lake on January 4, 1937, and four days later the survey operation commenced. By March 20 all work had been completed. On that day the party ate lunch in camp and dinner in Winnipeg, 350 miles distant. During that season a total of 61 monuments was erected.

Ten years later work on the final 168 miles of boundary line was undertaken and completed in a single season. According to one experienced Manitoba surveyor, March has always been an outstanding month for progress on northern surveys in that province. Some measure of credit for this performance record has been given to the lowly muskrat. It appears that the willingness of axemen to put their maximum effort into each day's cutting was linked to the availability of this small creature of the wilds. The open season for muskrat in Manitoba was usually the month of April and the men were invariably anxious to complete the survey work in time to permit them to go trapping.[10]

The work during the 1947-48 season was carried on under Gauer's direction. His first assistant was John G. Pierce, son of the man who had been prominently identified for so many years with this boundary survey project. Since no suitable landing places existed between Echoing River and Sturgeon Lake dog teams were used for haulage instead of planes, at least for a time. H. E. Beresford, Director of Surveys (Manitoba) and Surveyor General F. W. Beatty (Ontario) visited the field party in March in their capacity as commissioners. Henry Edward Maskew Beresford, who had succeeded S. E. McColl as Director of Surveys, Manitoba, was a younger brother of Herbert Graham Beresford, whose warnings of 1920 led to a resumption of boundary surveys in the following year. H. G. Beresford, who was both a Dominion and Manitoba land surveyor, served for a term in the Manitoba legislature as member for Rupert's Land. He died in 1938.

FIGURE 29. H. E. Beresford.

FIGURE 30
Edward Gauer at Monument 327, Manitoba-Ontario boundary survey, 1937.

FIGURE 31
John G. Pierce at boundary terminal monument, Hudson Bay, 1948.

Line cutting on the last leg began on December 24, 1947, and was completed at Hudson Bay, Mile 282, on April 6, 1948. In this concluding stage of the boundary survey Bruce W. Waugh, as Surveyor General, Ottawa, served as federal commissioner on the project.

John G. Pierce has described his sensations on participating in the highly precise closure on Ney's monument at the terminal point.

"Ney had erected a substantial wooden beacon," Pierce reported afterward, "over a concrete monument on the shores of Hudson Bay and it was indeed a thrill to see that beacon through the telescope of my transit while still about four miles inland."

Although dog teams proved most useful under special conditions, aircraft continued to play a key part in the final stage of field operations. A total of 34,070 miles were flown on 468 flights in connection with the project and 157,045 pounds of freight were hauled at a total estimated cost for all these air services of $16,775.00.

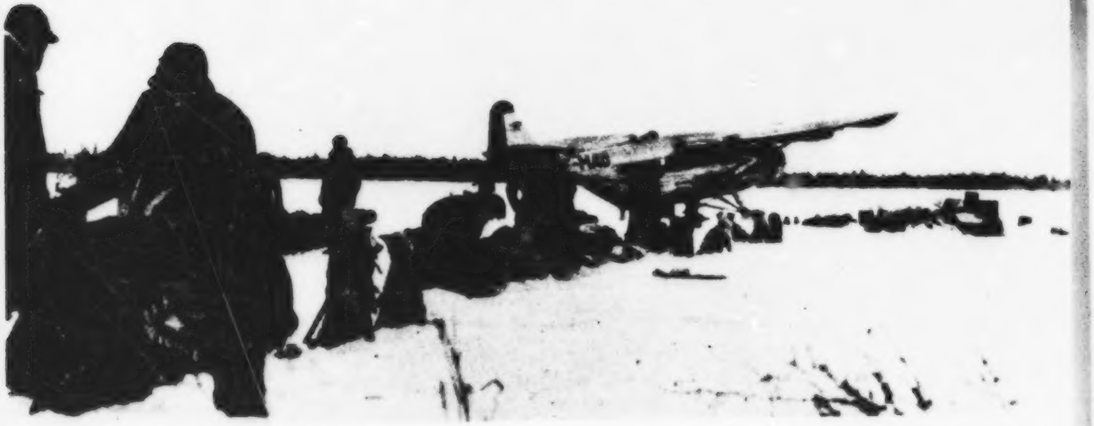


FIGURE 32. Transportation by dog team and aircraft, Ontario-Manitoba boundary survey, 1947-48.

Thus ended a 607½-mile-long survey that had spanned half a century, beginning in the era of toll gates and ending in the age of the aeroplane. The work of surveyors had served to substitute certainty for vagueness and doubt, had established clear fields for the provincial jurisdictions involved, and had thereby helped in an important way to promote interprovincial amity and cooperation. But again it should be pointed out that one of the most gratifying features of the entire undertaking, from a technical point of view, was the closure to within less than 16 feet on the terminal point, a feat achieved by surveyors who had commenced their line 282 miles away. Early in 1950 the three government entities concerned, having formally agreed upon the surveyed line as the true boundary, authorized the monumenting of the last span of the project and this task was carried out and completed during the summer of that year.[11]

4

MAP PRODUCTION AND REPRODUCTION

> *"He does smile his face into more lines than in the new map . . ."*
>
> —*Twelfth Night;* Act 3, Sc. 2.

The caveman's first awkward efforts to portray the locality in which he lived by carving on the walls of his abode or on clay tablets led step by faltering step through the ages to the colorful, complex, mass-produced paper maps of the mid-20th century. The achievement of map portability marked the first important forward stride in the art of cartography. This improvement was accomplished by the production of drawings on animal skins and, in ancient Egypt, by the discovery that the papyrus plant, found along the banks of the Nile, could be processed into sheets capable of carrying cartographic and other inscriptions. By 500 B.C. parchments were being produced from the skins of sheep and calves. Calf skin produced the better writing surface and became known as *vellum.* This material was much more durable than papyrus and became widely used as a medium for map making in the Middle Ages. Juan de Cosa's chart of the world, produced about 1500, was drawn on oxhide. Its appearance marked the beginning of a long series of maps illustrating discoveries made in the New World.

Improvements in map-making materials and in map-multiplying processes were inevitable in the face of increasing needs for the extension of man's knowledge of the earth. Long before the availability of such materials in the western world, paper (a word probably derived from papyrus) was in use in China. It appeared in the central part of that country about the end of the first century following the birth of Christ and by the fifth century paper had become the general medium for written documents in that part of the world. The introduction of paper making to Italy in the 13th century, followed by the advent of the printing press and the invention of moveable type in the 15th century, provided a tremendous impetus to the production of books, including elaborate folio editions of Ptolemy's *Geographia*.

The discovery of paper making heralded the approach of a solution of the materials problem, and the subsequent appearance of the printing press revolutionized methods of map reproduction. From the genesis of the printing process until fairly recent times maps required in quantity were reproduced from copper engravings. The acceptance of this engraving process and the production of impressions on paper marked the beginnings of a cartographic renaissance. This skilful art was developed by Italian goldsmiths, trained in engraving designs on goblets and tableware. In their work they used a greasy ink. By rubbing this substance into incisions they were able to press an image to paper. It was a natural step for them to begin engraving maps on flat sheets of copper and then to produce impressions on paper. The combined dexterity of hand and eye as well as the infinite patience required to engrave a map in this manner represent attainments almost beyond our comprehension today. All work on the engraved plate was reverse reading and all colors had to be added by hand on each printed copy. Two centuries were to elapse before the application of coloring in this laborious manner was abandoned in favor of an improved process. In the meanwhile the coloring of maps had become an independent trade within the map-making industry. By the middle of the 16th century this trade was recognized by artist's guilds and it was one followed, in his earlier years, by Ortelius.[1] Despite the advantageous introduction of metal in map making many maps were still being drawn on paper, others appeared on skins and yet others, such as the Waldseemüller map of 1507, were produced from wood engravings.

By the end of the 16th century conventional map symbols began to appear. These signs included church steeples representing villages, double lines signifying roads, and crossed swords marking battlefields of special importance. It is believed by many scholars that the coloring of map features originated with the Romans. In the early centuries of the Christian era topical maps were designed for specific purposes such as illustrating estates and depicting routes of pilgrims, and various locations with place names provided. These maps were beautifully drawn on parchment in many instances and often adorned by illuminated text. At any rate the coloring of geographical features "according to the nature of it" may be found in mediaeval maps of all sorts. Water appears in blue, roofs of dwellings in tile red, trees in green, and roads in brown. Vertical shading and the representation of mountains in plan came into practice about 1680. This new trend marked an advance of historic importance, enabling cartographers to show for the first time the length and breadth of a mountain range as well as to give indications of gradients.[2]

W. J. Blaeu (1571-1638), the noted Amsterdam printer and map maker of the 17th century, constructed a press that eliminated much of the back-breaking toil required to print a copperplate impression. Nearly two centuries later the German, Alois Senefelder (1771-1834), provided the map maker with a greatly improved method of reproducing his product. Senefelder began to experiment with copper etching in an effort to reduce the costs of printing. This process involved lettering in reverse with a scribing point which cut through a waxy acid coating on the copper. Because Senefelder made numerous errors in etching he concocted a correcting ink or medium composed of wax, soap and lampblack. This composition was formed by him into sticks and, when required, he rubbed the sticks in water and made a mixture which he applied by brush.

Senefelder also found it too expensive to practice reverse lettering in copper and, seeking a substitute surface, he discovered a highly polished floor tile of Kellheimer sandstone produced in nearby Bavarian mines. By chance he wrote a laundry list for his mother on a clean stone, using his correcting ink stick. Before cleaning the stone he poured acid over the surface and the result was a raised image of the lettering, capable of being printed. Employing a thin, gum-coated paper he lettered right reading with his correcting ink stick, wetting the finished work and rubbing its face down onto a new stone, thus transferring it to a greasy reverse image that could be etched. He observed, when wetting the work, that water adhered only to inked letters. This observation marked the birth of lithography. The next step was to transfer an image to a new stone and treat it with a mild acidulated gum solution that would not lower the non-image surface. He found that, if the stone were kept moist, greasy ink applied with a roller would adhere only to the image area and from this a reproduction on paper could be made.[3]

This new technique, based on the principle that generally grease and water will not mix effectively, developed rapidly and by 1845 lithographic prints in color had appeared in many countries. Lithography provided map makers with many advantages and, in fact, brought about a technical revolution that profoundly influenced map production and reproduction. It placed at the printer's disposal a mechanical process for reproducing flat or even transparent colors and eliminated an immense amount of manual labor involved in applying colors separately to each map sheet. Quantity printing of maps in color with good registration became speedier and less expensive. Uniformity of product was also assured. The benefits of this historic advance transformed the representation of relief in cartography, increasing flexibility and the power of visual suggestion. Colored hill-shading in brown was first added in 1858 to the Ordnance Survey (United Kingdom) one-inch map.[4] Soon after, line engravings were being color separated.

Although maps and charts continued to be engraved on copper these plates were transferred to lithographic stones for printing. The new technique gave rise to a different breed of map makers. At the beginning of the 20th century these were mainly lithographic draughtsmen who drew maps directly on stone, pulling transfers from one stone to another to provide color keys. Copper engraving work for map reproduction purposes continued in use well into the first quarter of the 20th century but by the 1920s the pen and ink drawing method had become standard practice in this field. The introduction of typography in the realm of map nomenclature was a natural forward step and by 1925 preprinted lettering was being used in most maps.

During the period when lithography was coming into wider use a new art, photography, began to exert an increasingly important influence upon cartography. Photography, in fact, may well be regarded as the handmaiden of modern cartography for it provided many benefits in the processes of map reproduction. As photographic coatings and chemical processes improved, glass became more widely accepted as a supporting medium for the production of negatives. In 1851 Frederick Scott Archer described a method in use in London in which a wet collodion was employed on glass sensitized by immersion in a silver nitrate bath. While wet the plate was exposed and this process became known as the *wet plate method*. This accomplishment marked the birth of photo-mechanical methods of map making and led to the development of photozincography, a process perfected by Captain A. de Courcy Scott in 1860. Grained zinc was first used in place of stone about 1889, with the introduction of rotary lithographic presses. By 1904 the first offset press made it possible to use right reading images on zinc printing plates, but stone flat bed presses continued to be employed well into the first quarter of the 20th century.

In the Europe of the Middle Ages, and especially in the Netherlands, as crafts or guilds of artisans associated with map engraving and map printing continued to flourish, special manual and other skills were passed from father to son and from brother to brother in succeeding generations. These family dynasties continued to be an accepted feature of the industry's growth over a period of several centuries. The practice spread to the British Isles and so it is not surprising that a respected and representative Scottish unit of the system, the Cunningham family, was destined to play a significant part in the progress of map making in Canada.

In concentrating upon the career of this family it is realized that undue emphasis on the place and importance of the copper-engraving method of map reproduction in Canada will result. But it must be kept in mind constantly that maps were being drawn in large numbers by hand on paper and on lithographic stones by Canadians during most of the period under review and that these activities required the services of highly skilled map makers.

Edinburgh-born Walter Charles Cunningham (1872-1941) began his six-year period of apprenticeship in copperplate engraving in his native city in 1886. Soon after the completion of his training he became foreman in the Ordnance Survey organization at Southampton. Toward the end of the century Canadian map-making firms were struggling with a steadily increasing volume of business. Efforts were made to attract to this country from the British Isles engravers skilled in copperplate work. As a result, W. C. Cunningham, responding to the lure of opportunities for betterment in a new land, came in 1898 to the Stone Company Limited, Toronto, to help build up a unit of copperplate engravers for that firm. At that time the company (later to form part of Rolph-Clark-Stone Limited) was performing a considerable amount of map reproduction work for the federal government. By 1900 W. C. Cunningham had induced a group of former associates in the craft in England to join him on the staff of the Toronto firm. This group included Walter J. Watts, George C. Silver, Alex Stewart, Dick Arnold, Robert Walker and George Sheirlaw.

In 1910 W. C. Cunningham was approached by officials of the Government Printing Bureau, Ottawa, in a successful effort to persuade him to leave Toronto in order to organize a copperplate engraving unit of that federal organization. The motives underlying Cunningham's move and, later, that of his Stone Company colleagues remain obscure but, in all probability, the desire for individual economic security played a large part in what, in those days, must have been a momentous decision to make. As a rule engravers lived rather insecurely, never certain of long-term employment in their craft. An opportunity, therefore, to enter govenment service would seem to offer the relatively rosy prospect of assured, continuous work. In any event the engravers who followed Cunningham from the British Isles to Canada did not hesitate long in joining their leader in Ottawa. Soon after this exodus of its most skilled craftsmen the Toronto firm ceased its copperplate engraving activities.

Another important factor in bringing about the recruitment of trained copperplate engravers by the federal government agency at this time may well have been the grave administrative difficulties experienced by the Government Printing Bureau in the first decade of the 20th century. The Bureau's malfunctioning was first exposed to the public in a report in 1910 by the Secretary of State, Hon. Charles Murphy. Mr. Borden (later Sir Robert), Leader of the Opposition, made reference to this statement in his address in the House of Commons on November 21, 1910, when he observed that ". . . the affairs of the Printing Bureau were hardly touched at all and surely my right honourable friend [Sir Wilfrid Laurier] in the light of the revelations that have been made before this session and at the beginning of the session in the report of the Secretary of State, will hardly deny that there ought to be some investigation into the affairs of the Printing Bureau in recent years . . ." The opposition leader used unusually strong terms in describing the situation that had developed in the Department of Public Printing and Stationery. "I do not purpose this afternoon," he said, "to enter into a discussion of recent scandals . . . The fact that there is an enormous admitted loss in this country in regard to the administration [of the Department of Public Printing and Stationery] . . . charges of inefficiency, maladministration . . . stealing, looting, grafting . . ."[5]

The committee inquiry that followed upon these startling disclosures was highlighted by the flight from Ottawa, before the investigation began, of the Superintendent of Stationery and the subsequent discovery of his body in the Detroit River.

Although during the first decade of the 20th century map drafting with pen and ink was well established in federal government mapping services, a considerable part of Ottawa's map production requirements was filled by private firms on the basis of competitive bids. Because of lack of administrative experience in the outside work allotment section of the Bureau staff unrealistic price lists were established in this area with the result that in some instances the federal government was virtually held to ransom through the instrumentality of exorbitant bids for map-making contracts by outside firms. With the rapid expansion of the economy then taking place in the western interior of Canada came heavy and increasing demands upon the Printing Bureau to perform

FIGURE 33. Pressroom of Mortimer Co., Ottawa in 1918. Hand-fed press and stones used in the lithographic process were still in use in the late 1930s.

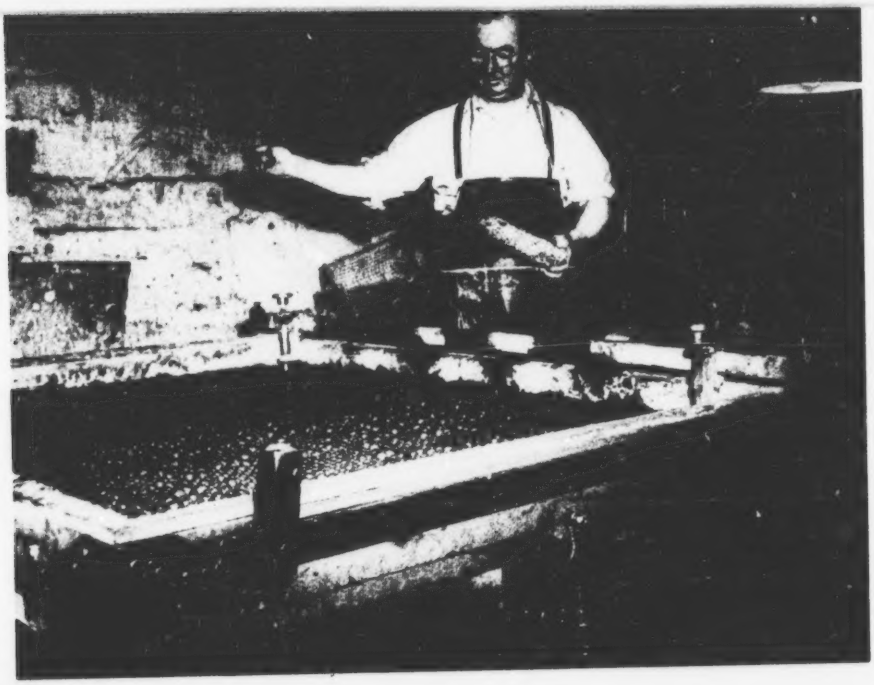


FIGURE 34. A lithographic plate is "grained" using metal balls and abrasives on a shaker platform. This abrades the surface evenly, helps the plates to carry moisture and makes the image areas more receptive to ink.

a class of work it was not equipped to handle. This steadily mounting pressure, in turn, compelled the government to rely more and more on the services of non-government establishments.[6] As reports and rumors of abuses in the system filtered out to the public the Undersecretary of State suggested to Bureau officials that requisitions for printing work and for map making should be checked carefully with a view to preventing the extraction of undue profits by private firms.

At the time of the inquiry into the affairs of the Printing Bureau a decision had been made by federal authorities to have their best and most important maps engraved in copper rather than on stone. This new departure in policy proved helpful in controlling the upward limits of competitive bids. When stone was being used for the purpose there was constant friction between government officials and contractors over the right to ownership and custody of the stones. With the advent of copperplate engraving for federal government purposes, and because of the much greater portability of the metal, there was no longer any necessity for plates to remain in the possession of the printer. With little risk and with relative ease the plates could be shipped from shop to shop and from city to city. Engraving firms, cognizant of the new circumstances, were no longer tempted, in making bids for government map reproduction work, to charge excessive rates on other processes involved simply because custody of the engravings remained with them.

Undoubtedly the Printing Bureau in Ottawa, to some extent, was a scapegoat for some politicians and a victim of certain civil servants in positions of responsibility whose work was habitually in arrears. Often, it seems, requisitions for maps as well as for other categories of printing work were delayed until the last possible moment, then marked 'Rush' and sent to the Bureau. But, in the main, the parliamentary inquiry proved timely and salutary. Administrative reforms were introduced in the Bureau that have since served to increase the efficiency and lower the costs of meeting government requirements. The inquiry also paved the way for the establishment in Ottawa, under the Bureau, of one of the ablest and most productive units of copperplate map engravers on the North American continent.

Another spur to the formation of the new unit in Ottawa was the trend, instituted by the federal government, toward the production in Canada of hydrographic charts of Canadian waters. Until the first years of the 20th century there had been a continuing reliance by Canadian authorities on the map-making and map-multiplying facilities of the British Admiralty in England. The first truly Canadian hydrographic chart, engraved and reproduced in this country in 1903, was that of Lake Winnipeg (Red River to Berens River), based on a geological survey map of the area with soundings resulting from Stewart's hydrographic survey of 1901.[7] It is probable that Mortimer Company, Ottawa, active at the time in performing mapwork for the federal government, printed this historic chart.

Earlier in this chapter reference has been made to the part played in the development of European map making by artisans whose skills had been exercised within close-knit family groupings. By bringing his son Walter to this country, W. C. Cunningham was soon able to demonstrate to Canadians how the special skills of the engraver's craft could be handed down from father to son and how this succession might remain unbroken over many years. It was in 1913, after his father had moved from Toronto to Ottawa, that Walter Alfred Cunningham (1895-1965) embarked upon half a century of work in the employ of the federal government in the capital city, interrupted by two periods of service in the Canadian army overseas in the First and Second World Wars. He began his apprenticeship as a copperplate engraver in the Government Printing Bureau on November 8, 1913, the first to serve such articles in this country. His salary during this training period was $85.00 a month. Seven years later he became a Junior Engraver and by 1928, when he was promoted to the rank of Senior Engraver, his monthly rate of pay had risen to $190.00.[8]

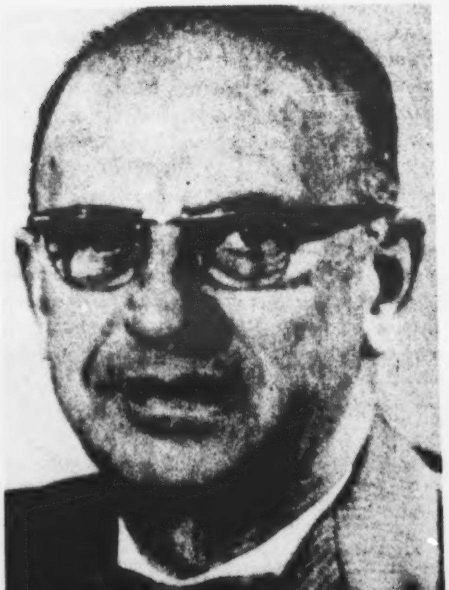


FIGURE 35. Walter A. Cunningham.

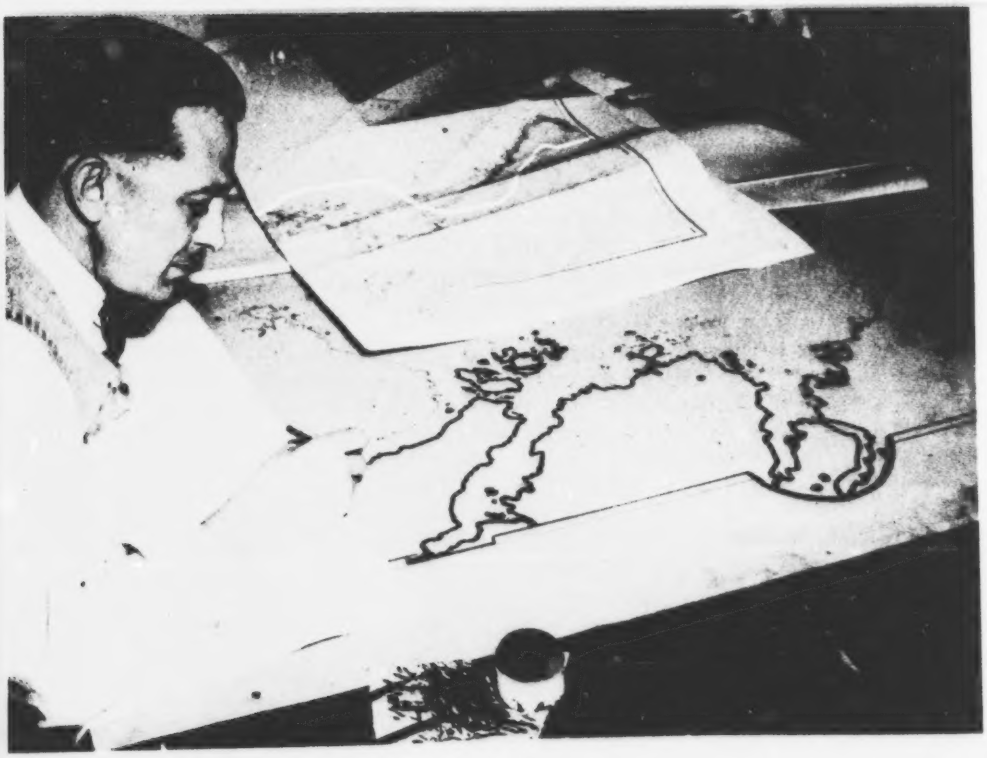


FIGURE 36. Engraver inking on zinc printing plate for water blue for hydrographic chart.

In 1921 the copperplate map engravers on the staff of the Printing Bureau were allotted among four federal government agencies in the capital city. Each of the four, namely, the Department of the Interior, the Geological Survey of Canada, the Militia Department, and the Naval Service were engaged in some aspect or other of map or chart making. This move marked the end of the copperplate engraving unit at the Bureau. Technically 'on loan' from the Printing Bureau to the Canadian Hydrographic Survey staff of the Naval Service, Walter Cunningham, along with his father and several other engravers moved to the Hunter Building and then, after about five years, to the Confederation Building in central Ottawa. Walter's uncle, Thomas Cunningham, came to Ottawa from the Old Land in 1921 and, after a term with Mortimer Company, became chief of the lithographic plant of the Department of the Interior, serving in that capacity until 1946. When Walter Cunningham returned to Canada after the Second World War he rejoined the Hydrographic organization. He found, however, that most of his fellow engravers of former days had either retired from service or had been transferred to the Mines and Resources Department to become lithographic artists or to join the photographic section in the Labelle Building.

Instruments used in copperplate engraving included at least a dozen steel points of various sizes, also a number of gauges such as double-line gravers employed in cutting highway routes among other purposes. In addition there was a special cutting instrument known as a 'lozenge' and also a dotter for making dotted lines or to indicate deposits of sand, especially along shorelines. No one at the time could have surmised that instruments such as these, after becoming relatively obsolete in Canadian map making for several decades, would return to use in a modified form of engraving, namely, scribing on plastic.

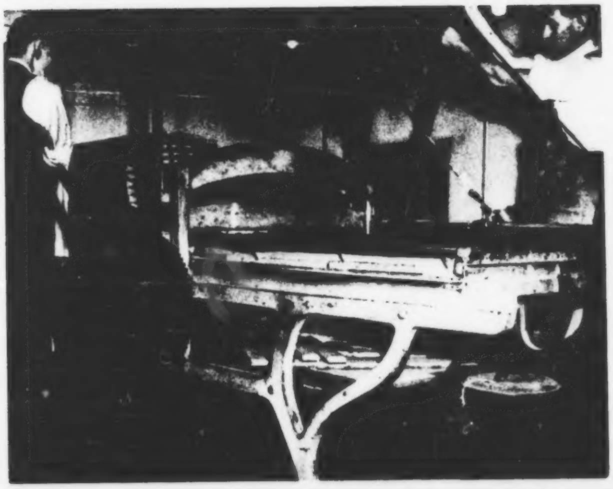


FIGURE 37
Transfer press in use. Pressure is being applied to effect transfer of image from stone or metal base to paper. Used until the 1950s in the Labelle Bldg., Ottawa.

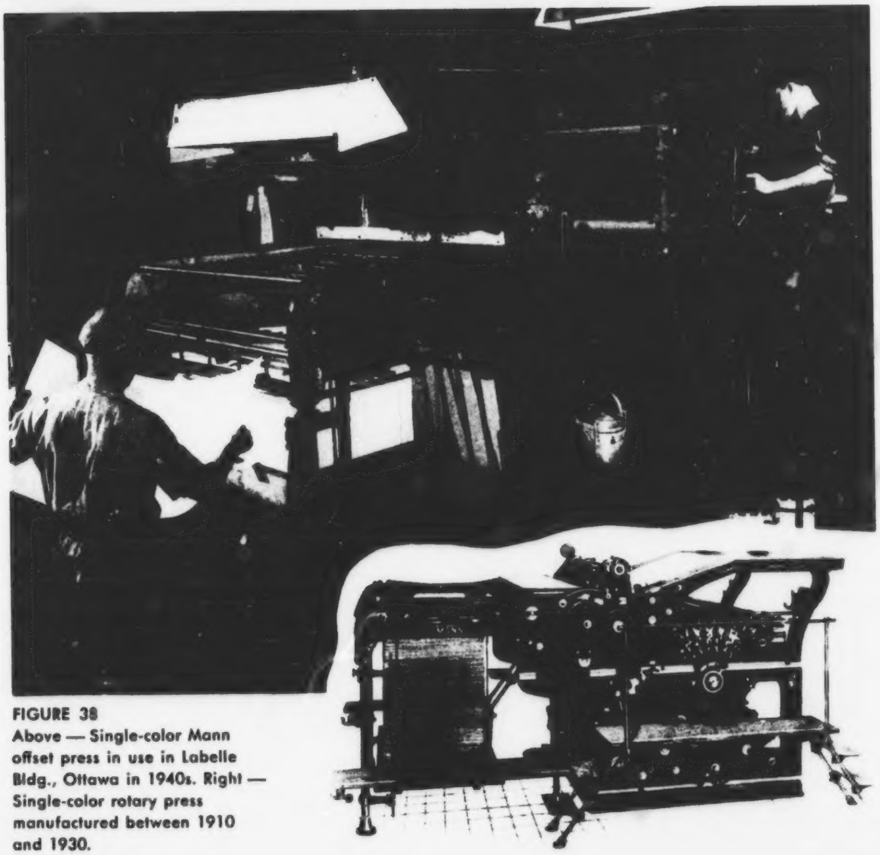


FIGURE 38
Above — Single-color Mann offset press in use in Labelle Bldg., Ottawa in 1940s. Right — Single-color rotary press manufactured between 1910 and 1930.

FIGURE 39. Operator compiling a map manuscript on a stereoscopic plotting instrument, aided by overhead projection of color images.

An event of considerable magnitude in the general progress of cartography in Walter Cunningham's time was the introduction of the rotary printing press. The direct result of this development was the significant speeding up of map-multiplying processes. As early as 1926 a rotary press was in operation in the Surveyor General's section of the Labelle Building and by 1932 three such presses were in operation in that organization. With the advent of the lithographic rotary offset press it became possible to print several thousand maps per hour, which compared with only about 100 map copies per day by means of the tedious copperplate process. This new press also permitted the printing of colors in exact register, and the cartographer was able to produce a greater variety of color combinations with fewer press runs.

By the 1940s the world of cartography was poised at the beginning of a great new advance in map-making techniques. That decade witnessed exciting experiments in the art of negative engraving, the key to which was the discovery of a plastic medium that would be suitable for map scribing.[9] Such a method of map reproduction offered a combination of solid advantages, provided the draughtsman could actually scribe a negative at printing scale and the result could be exposed to a lithographic printing plate. With success along these lines photography could be eliminated in the final reproduction stage and the original scribed line reproduced exactly. By 1940 basic instruments for use on a plastic material in the process of map making had been perfected by the United States Coast and Geodetic Survey, which had been entrusted with the production of a series of topographic maps for the Tennessee Valley Authority and was searching for a quicker method of reproducing maps.[10]

FIGURE 40
Map technician using stereoscope to assist identification of features on aerial photographs.

With the much wider use of airborne survey cameras following the Second World War and the accompanying demand for accurate, reliable maps, came increasing demands upon map makers to speed up their production processes. Prior to the war the map maker invariably kept well ahead of the surveyor and seldom, if ever, experienced pressure on his time from the weight of accumulated map data gathered in the field. But with new developments enabling the surveyor to rapidly obtain mapping information over vast areas, the map draughtsman began to lose his historical advantage in terms of working time. Leisurely progress, at the rate of two or three sheets per year, constituted a luxury in map production that no longer could be afforded.

The technique of negative engraving was a totally new process requiring a new material and new instruments. The wartime chemical industry of the United States had produced vinyl plastic and research was under way in Washington, D.C., following the war's end, to discover a suitable base for scribing material. Canadian government cartographic officials became aware of the American experiments in the early stages of these investigations. In particular, Edgar Douglas Baldock (1905-   ) clearly envisioned the immense possibilities inherent in the new approach. In 1946 vinyl was first used to produce artificial negatives. At the same time it was discovered that this type of plastic offered the most stable base for engraving work on negatives, in respect to durability and size. It was also capable of being easily cut without cracking. The development of thin, stable plastic sheets imparted fresh impetus to studies in faster map reproduction

FIGURE 41. E. D. Baldock.

methods being conducted in Canada and the United States. The discovery of a suitable solution for the all-important coating substance continued to elude researchers. On Baldock's instructions Montreal-born Joseph Paul Emile Antonio Metivier (1900-   ), Assistant to the Chief of the Photo-Mechanical Section, Surveys and Mapping Branch, Ottawa, made a number of visits to Washington in order to keep abreast of developments in this new technique. It was Metivier who, in the final analysis, produced in 1951 a workable coating that could be cut cleanly. The decks were now clear for wide-ranging action.

FIGURE 42. Paul Metivier.

FIGURE 43. W. H. (Bill) Miller.

The Canadian operation in this new field of endeavor moved along swiftly. Deputy Minister Marc Boyer and Branch Director W. H. Miller quickly perceived the advantages of the new method on viewing a demonstration of the process arranged by Baldock, and authorized its adoption in departmental work. The transition from pen and ink drawing of manuscript maps to negative, and positive, scribing in plastic was accomplished almost overnight. The speed with which this radical change took place is all the more astonishing in the light of the long-standing, rigidly-observed traditions and practices of the copperplate engraving craft, extending over centuries. The smoothness and effectiveness of the changeover was mainly due to the excellent teamwork of men such as Douglas Baldock, Paul Metivier, W. J. Clark, D. Howard Bagguley and Walter A. Cunningham.

Paul Metivier came to Ottawa in 1920 and entered the federal civil service as an apprentice metal printer, Topographical Survey of Canada, Department of the Interior. At the time he could speak little English but soon acquired fluency in the language.

In the slow-moving system of promotion of those times Metivier was not awarded a journeyman printer's salary until a quarter-century later. During those 25 years he was officially classified as an apprentice. In 1948 Metivier became assistant to C. Warner Besserer, Chief of the Photo-Mechanical Section. In 1961 he was appointed Chief of Reproduction.

After Deville's passing and as long as the Photo-Mechanical Section remained under the Surveyor General it was regarded as a "poor cousin" and endured considerable administrative neglect. When Maxwell George Cameron (1888-1951) became Chief Cartographer matters improved somewhat in this regard. Cameron, born jn Peterborough and educated in public and high schools in that Ontario city, graduated in 1910 from the University of Toronto in applied science. In 1913 he was commissioned a Dominion land surveyor and he subsequently performed considerable field work in the western interior and in northern Ontario. From 1927 until 1936 Cameron was in charge of the newly-formed oblique photograph section of Topographical Survey, Ottawa. He developed the technique of plotting from oblique photographs and generally was prominent in pioneer work in mapping in Canada from aerial photographs. During the Second World War Cameron played a leading role in the production of the 8-mile-to-the-inch aeronautical chart series required in connection with the Commonwealth Air Training Plan. From 1948 until his death in 1951 he was Chief Cartographer, Department of Mines and Technical Surveys.

Baldock succeeded Cameron and became Chief of the Map Compilation and Reproduction Division of that department. "For the first time", Metivier later observed, "we of the staff were authorized to travel within and outside Canada and to see how others dealt with problems in this field . . . Our views on map making broadened accordingly and we adopted and improved upon ideas inspired by these contacts." Metivier has recounted how Baldock, in the early 1950s, approached him and asked whether his men could turn out a job by using plastic as an engraving medium. "Let's take this gradually" was the basic admonition but the outcome proved so satisfactory that glass plates and all that were quickly abandoned and the tedious, often dirty work, hallowed by long usage and tradition, suddenly became obsolete. The volume of production mounted impressively and reached several times the amount of work formerly produced. One notable loss in the transition from one practice to the other was that of the draughtsman's individuality in craftsmanship. In earlier days it would be possible to tell, at a glance, what artisan had drawn a particular map. On the other hand large gains were made in obtaining a desirable uniformity of product as well as greater variety in the use of color and, above all, a far greater speed of output.

One of the formidable problems of the transition stage was that of the insertion of place names in the scribing process. This was brought about eventually by the use of the type-overlay system.

Baldock realized that rather than attempt to convert the old hands of the staff, steeped in the traditional but slower practices, to the new system it would be wiser to select ten or twelve newcomers to the expanded staff and to teach them how to scribe from the outset of their training. But it was first necessary to find a man able to teach, conversant with long-established methods, yet adaptable to the new order of things. Baldock found such an instructor in the person of Walter A. Cunningham. Early in 1953 he asked Cunningham to visit Washington and to acquaint himself with advances made there in the plastic scribing method. On his return to Ottawa Cunningham began to impart the benefit of this new technique to the young draughtsmen in a series of

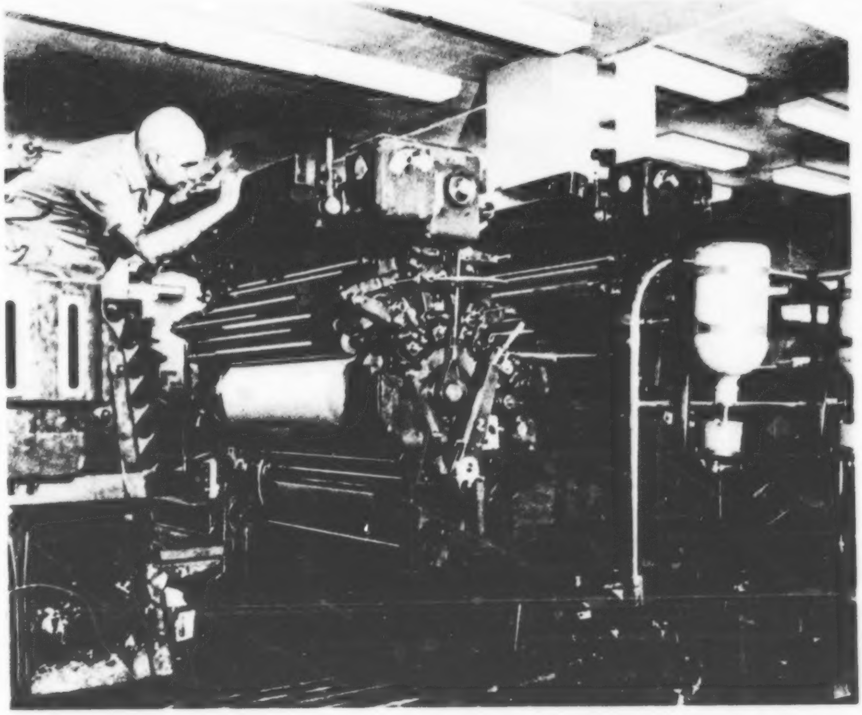


FIGURE 44. Two-color Mann offset press (25 x 38") used by Map Compilation and Reproduction Division, Ottawa (now the Directorate of Map Production) for printing multi-color maps and charts. Installed in 1957.

lectures. The system was soon launched and the first experimental map was the Gambo sheet, Newfoundland. The highly satisfactory results obtained convinced federal authorities that a change to the new system was advisable.

In Canada plastic sheets were first used in map production, in 1952, in that stage of the map-making process where the areas (as distinct from the lines) of a map that will be printed in a given color are placed on the printing plate. Formerly this had been done on the plate itself by laborious and delicate handwork. But with the introduction of plastic sheets, a system was developed whereby the *outlines* of the color areas were printed on the plastic in a nonphotographic blue line. Using this blue line as a guide, the color areas were filled in with water-soluble opaque. The whole sheet was then dyed, but the color areas that had been protected by the opaque could be washed clean, leaving an "open-window" negative. Map makers could thus provide reproduction material* for both line and area colors. This eliminated the long delays that formerly occurred when an area color printing plate broke down during the printing processes, because with this system a new plate could be made in a matter of minutes.

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*"Reproduction Material" is the term used to refer to the various draughted sheets of plastic which are used to make lithographic printing plates.

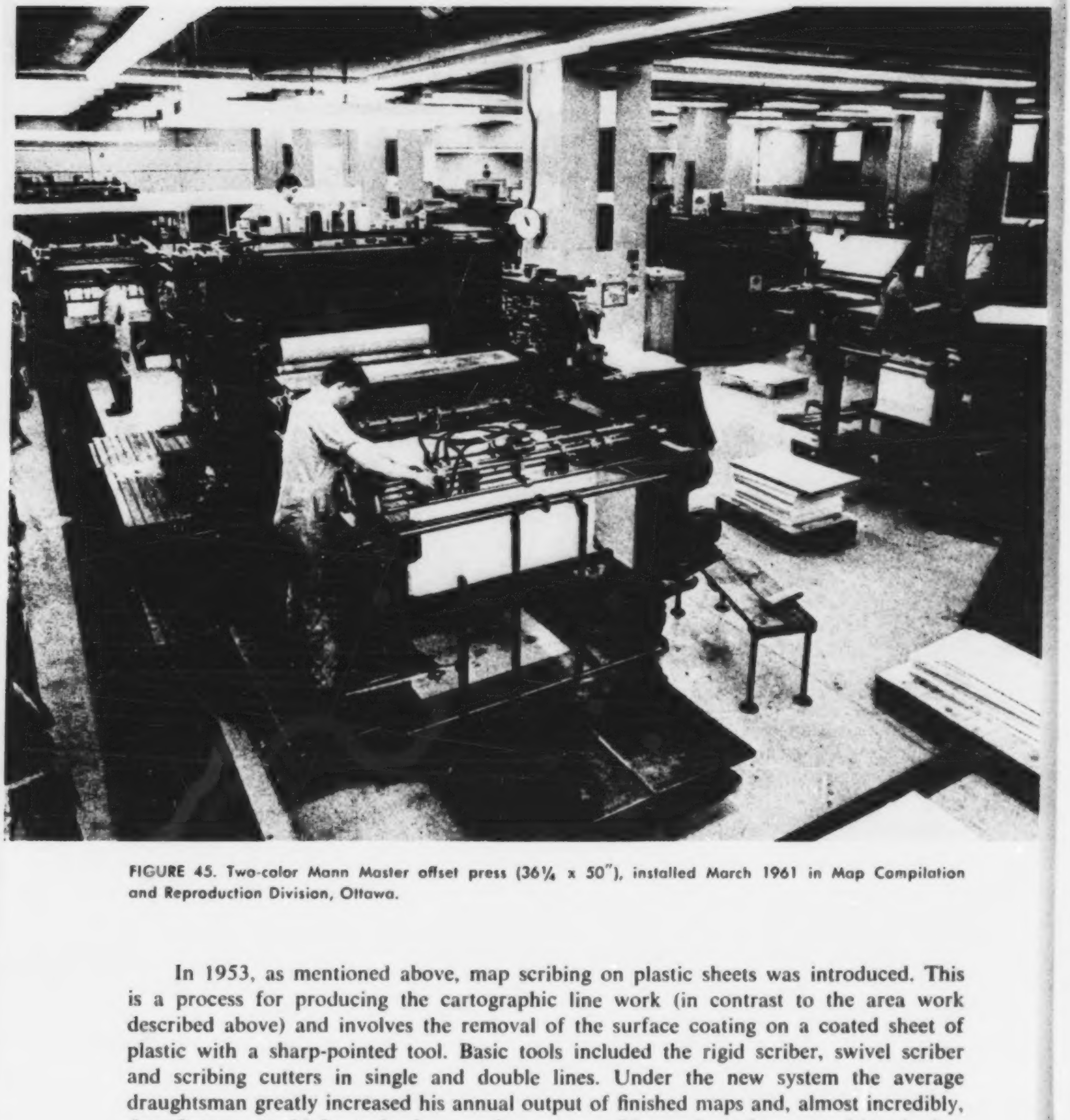
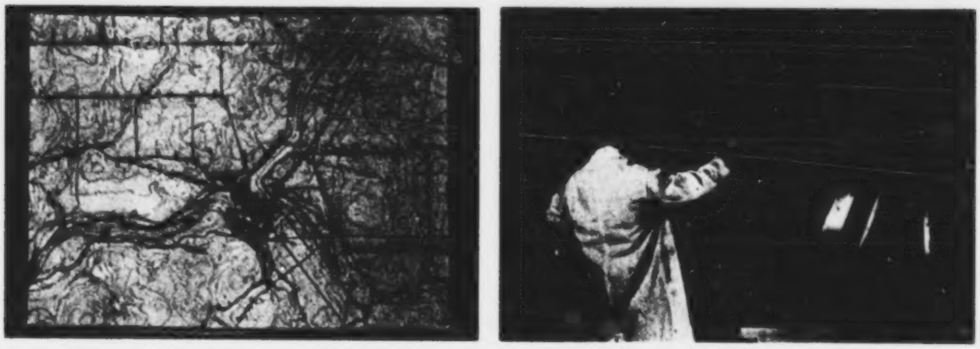


FIGURE 45. Two-color Mann Master offset press (36¼ x 50"), installed March 1961 in Map Compilation and Reproduction Division, Ottawa.

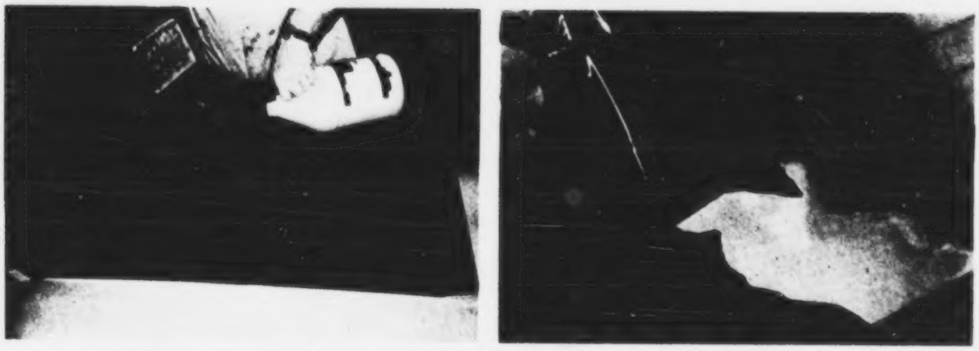
In 1953, as mentioned above, map scribing on plastic sheets was introduced. This is a process for producing the cartographic line work (in contrast to the area work described above) and involves the removal of the surface coating on a coated sheet of plastic with a sharp-pointed tool. Basic tools included the rigid scriber, swivel scriber and scribing cutters in single and double lines. Under the new system the average draughtsman greatly increased his annual output of finished maps and, almost incredibly, draughtsmen could be trained to perform acceptable work under supervision in less than one year. The instruments were simple, line weights could be well maintained and difficult symbols could be drawn with relative ease. In addition the idiosyncracies of individual penmanship were eliminated, permitting more than one person to work on a specific map.

FIGURE 46. Modern processes in map making.



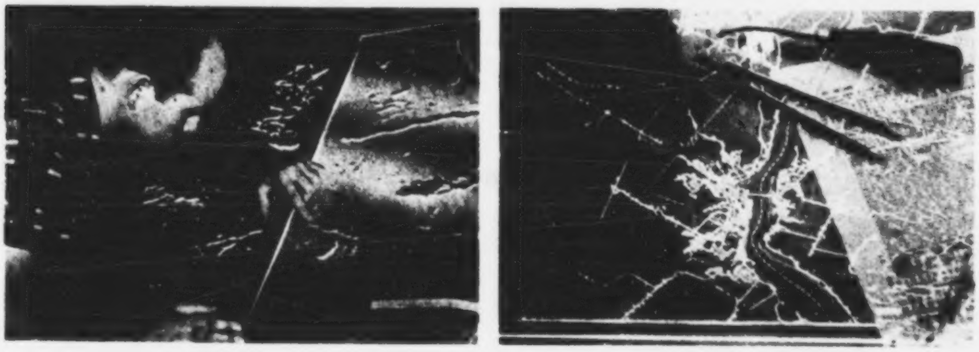
Manuscript map.

Applying light-sensitive coating to peelcoat.



Developing the peelcoat by use of solvent.

The peeling process.



Checking open-window negative.

Type (place-name) affixment.

This successful venture with the new system marked the beginning of a profound revolution in the realm of map making in Canada. It was a process first developed and used in this country by far-seeing and resourceful map makers of the Map Compilation and Reproduction Division of the Surveys and Mapping Branch, Ottawa. The changes in methods brought about by these craftsmen and others gave to the Canadian cartographer the greatest flexibility he has ever enjoyed in map design and map production as well as map reproduction work.

5

THE ROLE OF SURVEYS IN THE STORY OF MONTREAL

Central Montreal is situated on the largest island of an archipelago in the St. Lawrence River near the mouth of the Ottawa River. By the time Cartier had arrived on his first visit to the place a palisaded Indian village had been constructed on a hillside and called by the natives, Hochelaga. There is evidence that this settlement existed before the year 1400. For a time, after the epochal voyage of Columbus, Hochelaga served as a mother community of the North American continent. Today the same island, along with companion islands and nearby mainland areas, together comprise a metropolitan region inhabited by upwards of three million persons. Montreal has become not only Canada's largest city but, next to Paris, the largest of all French-speaking cities in the world.

More than four centuries ago, on the summit of the hill that for so long dominated this principal island, Indians of the Iroquois nation used forest cover as they hid from enemies, or waited to descend upon them. Today their descendants are employed as specialist workers on the 'high steel' framework of skyscrapers that, from street level, appear to dominate the once-impressive Mount Royal, from which this urban colossus has derived its name. Ste. Catherine Street, an important shopping promenade, now extends across the central business section of the city along the third of five hillside terraces that mark the community's gradual climb through recent centuries from the river up the mountainside. The terraces are the remains of ancient beaches and testify to the spasmodic recession of the seawaters in this locality during the long reaches of geological time.

Before the white man arrived in what is now central Canada the Indians used the gully cleaving Mount Royal as a portage route, carrying their canoes from the St. Lawrence River to Rivière des Prairies. The latter stream formed the beginning of a water highway leading up the Ottawa River, down the French River into Georgian Bay and, by way of Lakes Huron and Superior, to the western interior of the continent.

Champlain bestowed the name 'Place Royale' on a riverside trading post located about a mile from Hochelaga settlement and this site continues to be the pivotal position of Montreal's present-day, 8-mile-long port development. In 1642 Paul de Chomedey de Maisonneuve arrived in this locality with about 60 persons, people brought from France to serve as soldiers and settlers. As the first executive officer of Compagnie de Montréal, Maisonneuve selected Place Royale as the site of the new European community and named it Ville Marie. In that vicinity farmland concessions were granted and surveyed. Land surveyors known to have been active in the settlement or near it during the latter part of the 17th century were Bénigne Basset, Jean Lerouge, Gilbert Barbier, Robert de Villeneuve and Louis-Marie Boucher *dit* Boisbuisson.

The 18th century was only a few years old when the name Ville Marie, now a settlement of 1,500 persons, was discontinued in favor of the appellation, Montreal. The settlers soon wearied of the restricting stockades and by 1660 a village had grown up outside the fort, its forty or so dwellings extended in two straggling rows facing each other across a rough trail.

The beginnings of Westmount have been traced to this early period. By a deed in Maisonneuve's handwriting, and over his signature, a grant of land on Côte St. Antoine was made to Jean Leduc in 1662, the first of a number of land grants made in that locality during the 1660s. Pierre Hurtubise received a grant of land in that vicinity in 1687 with the stipulation that a house should be erected on the property within three years. About this time the Sulpicians founded a mission for Indians, the boundaries of which extended into what is now known as Westmount. The name Priest's Farm, in fact, was long in use locally to denote the area between present-day Wood and Atwater avenues.[1]

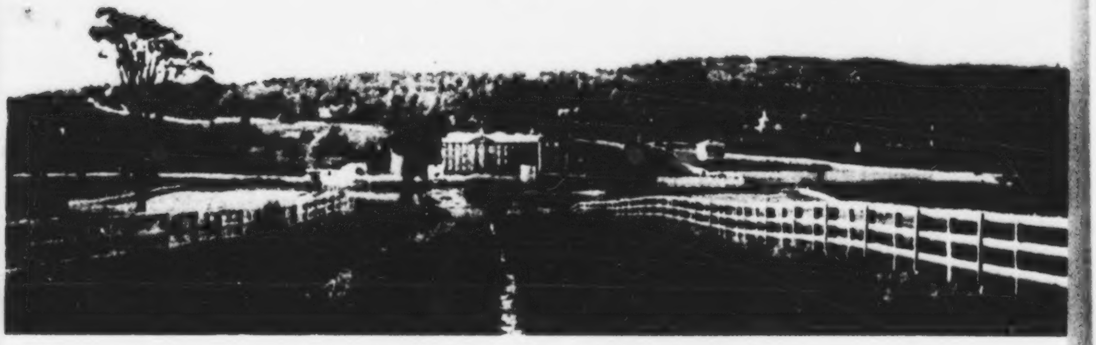


FIGURE 47. Priest's Farm, Côte des Neiges Road.

The first streets of the embryo town were planned in 1672. In March of that year the Sulpician Superior, Dollier de Casson, with the aid of the surveyor Basset, laid out these pioneer thoroughfares within the present limits of central Montreal. They marked the courses with great care, using posts bearing the leaden seal of the Sulpician Seminary. In some instances the trails already in use were transformed into streets. In other cases entirely new roadways were required. Notre Dame Street, then the principal thoroughfare, was made 30 feet wide. Saint-François Street, later Saint François Xavier Street, was named after de Casson himself; Saint-Paul Street, initially a pathway from the old fort to Hôtel-Dieu Hospital, after Paul de Chomedey de Maisonneuve; Saint-Jacques (St. James) Street after the founder of the Seminary of Saint-Sulpice, curé Jean-Jacques Olier de Verneuil (1608-1657); Saint-Pierre (St. Peter) Street after the great apostle "and also out of respect to M. de Fancamp, one of the founders of Montreal who bore that name."[2]

During the decade after 1672 the tiny community was not precisely a beauty spot. The condition of streets was a constant source of complaint. Some property owners completely ignored their existence, cultivating across rights-of-way. This led to a prohibition of all crop-raising activities on roadways. Each proprietor was permitted to enclose his lot with stakes or hedges. Nevertheless streets remained in uneven condition as efforts by the authorities to induce each property owner to pave the street to the centre line in front of his dwelling met with indifferent success.[3]

In addition to its importance as a fur-trading centre the early town was the natural outfitting point for the inland explorations of La Salle, Jolliet, Marquette, Duluth, Cadillac, LeMoyne, La Vérendrye and others. Two of the many sons of Charles LeMoyne, Baron of Longueuil, in fact contributed much to early explorations of the Mississippi River and to the founding of Louisiana. In 1723 the town's fortifications were strengthened by the erection of stone walls for the wooden stockades surrounding the settlement. The enclosed area embraced 110 arpents, or about 93 acres, and the walls remained intact for almost one hundred years. By 1761 the population of Montreal

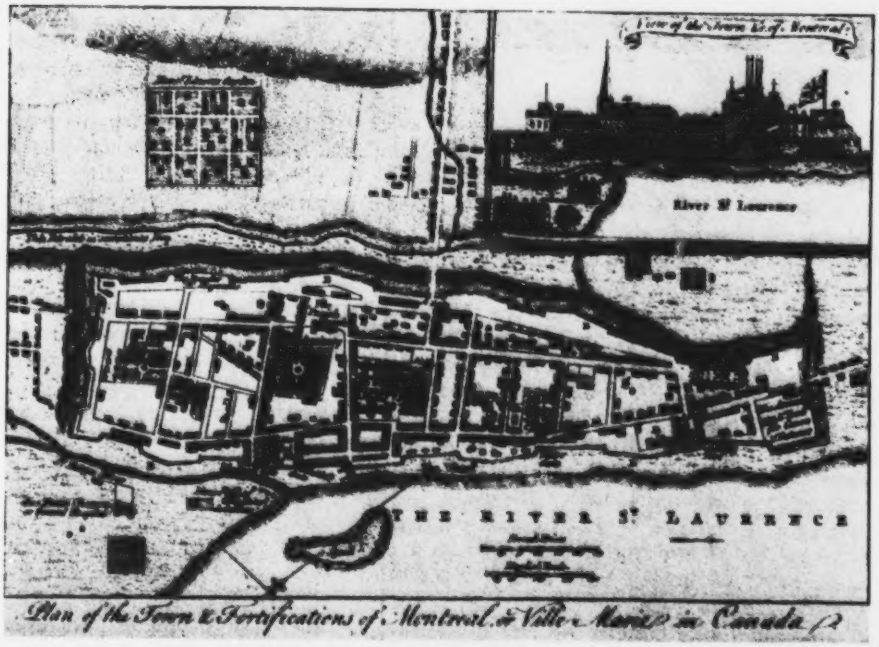

View of the Town &c. of Montreal
River St Lawrence
THE RIVER St LAWRENCE
Plan of the Town & Fortifications of Montreal or Ville Marie in Canada

FIGURE 48. Engraving based on 1758 plan by Jeffrys.

exceeded 5,000. Land surveyors prominent in Montreal and vicinity during the 18th century included Jean Boutin, Jean-Baptiste Belisle, Gabriel Boudreau *dit* Graveline, Louis Charland, Toussaint Beaudry, Joseph Papineau, Jesse Pennoyer, Charles Basset, François Papineau, Joseph Perrault, Amable Dezery, François-Enouville Lenoix, Pierre Arsenault, Jean-Baptiste Grenier, and René de Couagne.

The American Revolutionary War brought in its wake some highly significant changes in the development of the island community. Its population increased and became more varied. Men trained in the British civil service and in British forces augmented the flow of other emigrants from the Old World. In the streets officers and soldiers mingled with black-robed priests as well as with students wearing brightly colored sashes, nuns in black and grey, farmers, lumbermen, Indians and laborers, the latter clad in serviceable homespun. The peopling of empty lands, especially in the Eastern Townships, by United Empire Loyalists and others, heralded the approach of a dramatic change in function for the burgeoning community on the island of Montreal. The core of the original settlement had been located on a hillock near what is now St. James Street. As business enterprises gradually advanced up the escarpment to Ste. Catherine Street, the local world of commerce tended to gravitate about Phillips and Dominion squares. This intrusion into what had been a district of residences only, resulted in a retreat of home owners up the south side of Mount Royal to the Sherbrooke Street plateau.

At numerous points in Upper and Lower Canada the forests and the frontier receded as land was cleared and crops raised. When grain was produced in excess of strictly local needs this product began to reach Montreal for shipment overseas. In return the British Isles began to send manufactured goods to Canada to help meet the requirements of the steadily growing population. The merchants of Montreal responded vigorously to the unfolding prospects and the city took its first steps towards becoming a national seaport.

Up to this stage in Canada's growth, Quebec City, as the administrative and military centre of Lower Canada, had been a more populous, more thriving, and generally more important community than Montreal. A principal factor was the tendency of vessels, bound upstream between the two places, to be delayed in the approaches to Montreal by adverse winds and currents. But with the appearance in the St. Lawrence River of steam-powered, ocean-going ships, navigation problems eased. As Montreal's port activities expanded the island city rapidly forged ahead of Quebec City. Young people began to move from the latter to take advantage of the improved economic opportunities in Montreal. Important discoveries of natural resources multiplied in the province and these developments along with better transportation combined to widen the disparity in growth between the two ports.

The increase in traffic in Montreal harbor emphasized limitations imposed by hazardous river approaches and by primitive dockside arrangements. But directly opposite the town there was a deep-water channel enabling ships of several hundred tons to approach close to shore. The sharp declivity of the riverbank at the waterfront formed a natural wharf over which cargoes could be loaded or discharged. During the closing years of the 18th century, although a plank-faced dock had been constructed at the riverbank, goods for the most part continued to be boarded or unloaded directly from or on to the beach.

Attempts were made at this time to improve navigation west of Montreal wherever a series of river rapids dictated arduous and costly portages. By order of the Governor,

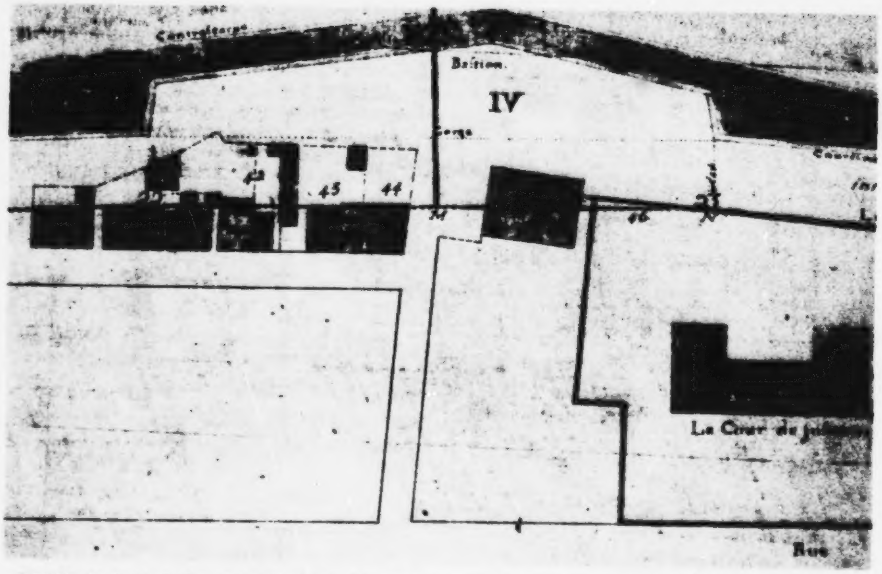


FIGURE 49. Part of plan of fortifications of Montreal, drawn by Louis Charland, 1803. From copy by J. Rielle, P.L.S. Today's Rue St. Jacques runs horizontally from the left margin to meet Rue St. Gabriel at about the centre of the diagram. Rue Notre Dame extends horizontally along the lower margin.

and under the supervision of Lieut. William Twiss, R.E., work began in 1779 on the construction of six-foot-wide canals and tiny locks at Coteau du Lac, Cedars, and Cascades. These projects included enlargement of Lachine Canal. Its length was extended to 8½ miles and four new locks were provided to overcome the 42-foot height differential.

As early as 1815 town-planning projects were under study by a civic commission, one of whose members was James McGill, Scottish founder of McGill University. The pattern of urban growth was considerably influenced by immovable physical barriers in the form of the mountain and the watercourses in its vicinity. These natural features tended to confine development of downtown Montreal to some 1,300 acres wedged between the base of Mount Royal and the St. Lawrence River. Local geography also compelled the spreading city to flow around Mount Royal to form suburbs such as Outremont, Mount Royal, Ville St. Laurent and, in recent years, to complete the encircling movement, Côte Saint-Luc and Hampstead. By 1840 the population of the city had grown to 40,000.

Towards the eastern end of the island of Montreal other municipalities were developing such as Pointe-aux-Trembles, Montreal-Est, Anjou, Saint-Leonard-de-Port Maurice, and Montreal-Nord. Along the south shore of the main island from its western tip towards its centre, other communities eventually began to take shape, places such as Baie d'Urfé, Beaconsfield, Pointe-Claire, Dorval, Lachine, La Salle, and Verdun.

Directly across the St. Lawrence from central Montreal, on the southern mainland, other communities such as Longueuil, Saint-Lambert, and Montreal-Sud sprang into prominence.

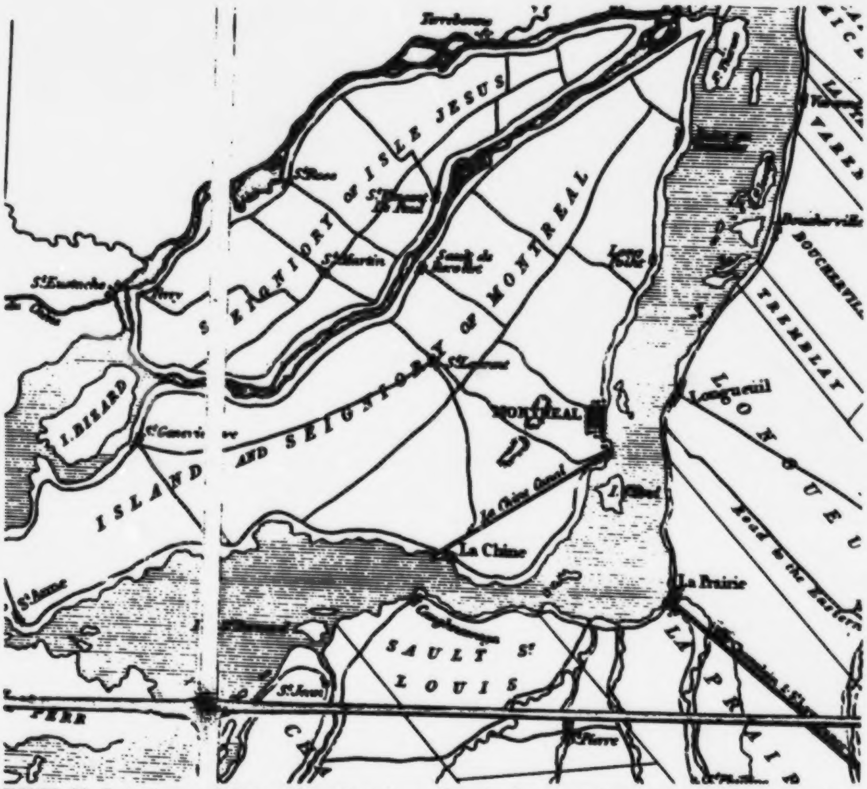

Terrebonne
SEIGNIORY of ISLE JESUS
St Rose
St Martin
St Eustache
SEIGNIORY OF MONTREAL
ISLAND AND SEIGNIORY
I. BIZARD
St Genevieve
St Laurent
MONTREAL
Longueuil
LONGUEUIL
BOUCHERVILLE
Boucherville
TREMBLAY
La Chine Canal
La Chine
La Prairie
LA PRAIRIE
SAULT St LOUIS
St Anne
Road to the Eastern
St Pierre

FIGURE 50. Part of map of Eastern Townships, Lower Canada. From actual survey for the British American Company by A. Wells, P.L.S. Published by John Arrowsmith in London, England, May 1842.

On May 25, 1855, the Provincial land surveyor, H.-Maurice Perrault, wrote a letter to the chairman of the road committee of Montreal municipality, summarizing progress over the years in the surveying and mapping of the area:

"I have the honour to report that, in compliance with instructions from the chairman, Mr. Grenier, bearing date of December 7th last, I have traced out and run the North West boundary line of this city from the North Angle to the Western Angle.

"In the course of this operation I have found that the intermediate boundary stones, such as those planted at Papineau, or Victoria Road, and at the Main Street of St. Lawrence suburb, were not in a straight line with the two terminal stones although represented as such in sundry old and new maps.

"It appears from various records that these limits were originally laid down by William Sax, Deputy Provincial Surveyor, under a Proclamation from His Excellency the Governor General, bearing date of May, 1792; and that on the 16th day of August, 1798, the said William Sax planted three hewn stone bornes to define the said limits; the one was planted on the bank of the River St. Lawrence near the present Ste. Mary Street toll gate; another was planted on Mr. Clarke's land at Main Street, St. Lawrence suburb, a short distance east of the present toll gate; and the third opposite Cantin's shipyard, also a short distance from the present St. Joseph Street toll gate.

"Subsequently the outlines and boundaries of the city were drawn and extended from the above three old bornes in June, 1826, by the late Theodore Davis, duly commissioned land surveyor, at which time he planted 10 additional stone boundary markers and seven cedar posts to define and establish the said limits. This operation was performed at the request of the magistrates for the city and district of Montreal.

"I have prepared the accompanying plan from an actual survey of the whole of the extent of the aforesaid Northwestern boundary line and have laid down the said line as running from boundary stone to boundary stone . . . Should it be found necessary, or advisable, to make a more minute survey in order to ascertain where deficiencies may exist, I shall be ready at any time, on receiving your instructions, to do so immediately."[4]

Some ten years later a plan of the city was made from a trigonometrical survey and for a number of years this was the only official map available in Montreal. In 1881 an atlas of the City of Montreal, the work of Charles E. Goad, C.E., was published, based on special surveys and official plans. These maps showed all buildings, their numbers, and the names of their owners. In 1890 Goad published a second edition of this atlas, including a map of the city that was widely regarded as the best and most comprehensive of its kind up to that time. Goad began his career in engineering with the Toronto, Grey and Bruce Railway. By 1876 he was Chief Engineer of the Halifax and Cape Breton Railway. He left railroading to inaugurate and promote a system in Montreal of insurance surveys and plans of the city, later extending this type of work to large cities and towns of Great Britain.[5]

During the 19th century a number of other surveyors were busily occupied in the Montreal area. In the early years of the century these included Eugène Guy, Pierre Guy, John Adams, Richard Hay and Alexander Gibbs. The notable mapper of the Canadian North-West, David Thompson (1770-1857), who had retired from exploratory and international boundary work, performed surveys in the vicinity of Montreal in the early 1840s. His remains rest in Mount Royal Cemetery.

In 1850, at the age of 16 years, Joseph Rielle (1834-1915) was articled to the Montreal firm of surveyors, Ostell and Perrault. After four years with that partnership Rielle served as assistant engineer with the Montreal Harbour Commission, then entered general surveying practice. In 1904 he was presented by his fellow land surveyors of the Montreal district with a testimonial marking the fiftieth anniversary of his commissioning as a qualified surveyor.[6] His records, plans, and field notes are in possession of the surveying firm of C. C. Lindsay and R. J. Lindsay of Westmount. The transfer of survey records from one qualified surveyor to another by sale, gift or bequest is authorized under Quebec laws.[7]

Joseph-Emile Vanier, born in Terrebonne, was another who contributed in an important way to the surveying of Montreal properties. He began his professional career

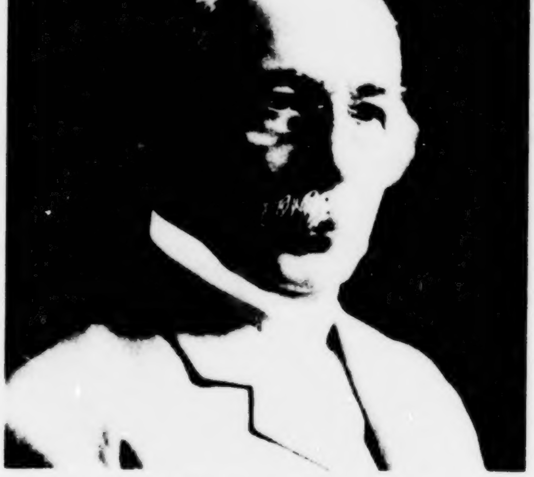


FIGURE 51. Joseph Rielle.

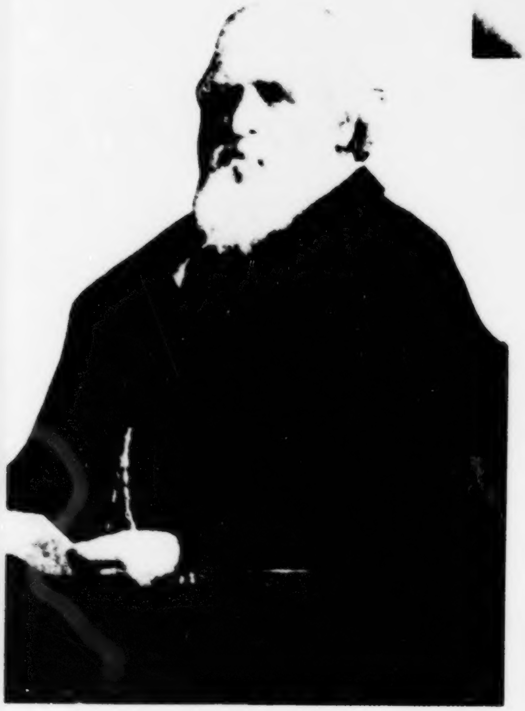


FIGURE 52. F. W. Blaiklock.

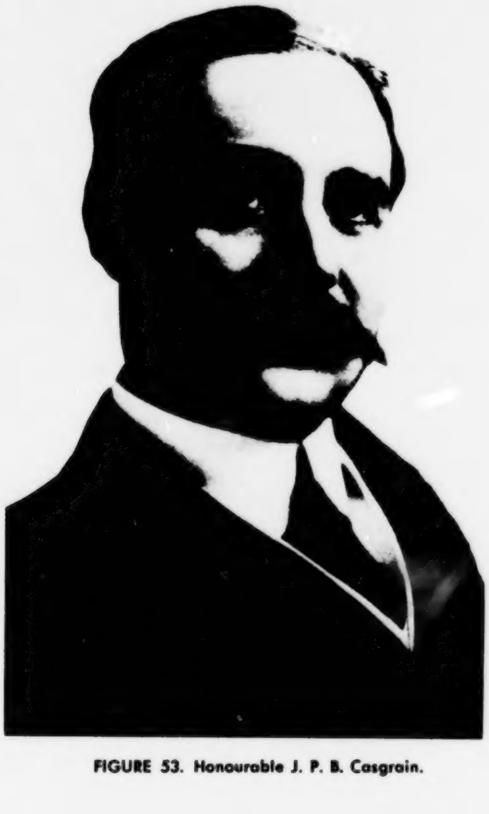


FIGURE 53. Honourable J. P. B. Casgrain.

in Montreal in 1879. For many years his firm of engineers was considered widely to be one of the most eminent in its field in Canada.[8]

A name synonymous with the advancement of the profession in Quebec province is that of Joseph Philippe Baby Casgrain (1856-1939) who was commissioned a Provincial land surveyor in 1877 and a Dominion land surveyor in 1881. Born in Quebec City, Casgrain belonged to one of the first French families of New France. He was named to the Senate at Ottawa in 1900. Although Senator Casgrain had a distinguished career in the field as a surveyor his most enduring contribution as a Canadian was made in promoting the best interests of his fellow surveyors through the agency of their professional organizations. He was a member of the board of directors of the Corporation of Quebec Land Surveyors for fifty consecutive years and in 1938 was made permanent Honorary President of that association.

Brian Douglas McConnell (1836-1930) was also prominent in the making of surveys in and around Montreal during the latter part of the 19th century. Born in the Gaspé and educated there as well as in Quebec City and Montreal, McConnell began to practise in 1869. He was on the party that made the initial surveys for the Canadian Pacific Railway along the north shore of Lake Superior. Later he became City Engineer of Westmount. J.-Louis Michaud (1851-1915), born in Rimouski, became a Provincial land surveyor and, in 1882, a Dominion land surveyor. After many years in the field in the Canadian North-West, Michaud entered private practice in Montreal.

Other names of surveyors active in the 19th century in Montreal and vicinity include Marius Dufresne, F.-T.-V. Regnaud, N.-C. Mathieu, Clement H. McLeod, Ernest Bélanger, Henry Irwin, John Ostell, J.-Hermyle Leclair, W. McL. Walbank, Thomas Guérin, Clovis Leduc, Thomas Kirk, J. P. Mullarkey, Frederick William Blaiklock (1820-1901), commissioned in 1843, and Percival Walter St. George, a civil engineer, who became City Surveyor of Montreal in 1883.[9]

In 1875 a three-man Commission of Engineers was appointed to investigate methods for improving the harbor at Montreal. Robert Bruce Bell of Glasgow, Major-General Newton of New York, and Sandford Fleming of Ottawa were its members. Among those submitting views to this commission was City Surveyor MacQuisten of Montreal, who testified on the subject of flood levels. MacQuisten, in the great flood of 1861, claimed that he had sailed in a boat through St. Ann's Ward when that part of the city was under three feet of water.[10]

Two years after their appointment the commissioners reported that some serious discrepancies had been found in existing charts of the St. Lawrence River at Montreal. New surveys and soundings were recommended. Results of these new measurements, as laid down on a large-scale plan, embraced the stretch of river between Victoria Bridge and Longueuil. Soundings were numerous enough to permit the drawing of contour lines, revealing at a glance depths at all points.[11]

Again in the spring of 1897 a resurvey of the river began "to meet the general demand for perfected charts and to keep pace with the deepening and general improvements to the ship channel." The field work on this survey was completed in 1907. The survey consisted of triangulation and topographical work from Montreal and Quebec City, and hydrographic surveys from Montreal to Pointe Platon. From the latter place to Quebec City extensive soundings had been made a few years previously and it was not considered necessary to repeat this work.[12]

On the island of Montreal other developments of significance to surveyors and to the general public were taking place. The Municipal Council of Montreal, by a resolution on October 2nd, 1905, divided the area within city limits into two parts by designating Boulevard St. Lawrence, now St. Lawrence Main, as the north-south line of division. This important thoroughfare extended from the St. Lawrence River to Rivière des Prairies. All avenues cut by this traffic artery would henceforth be described as east and west respectively and street numbering, accordingly, would begin on each side of this dividing line and mount in orderly sequence in each direction.[13]

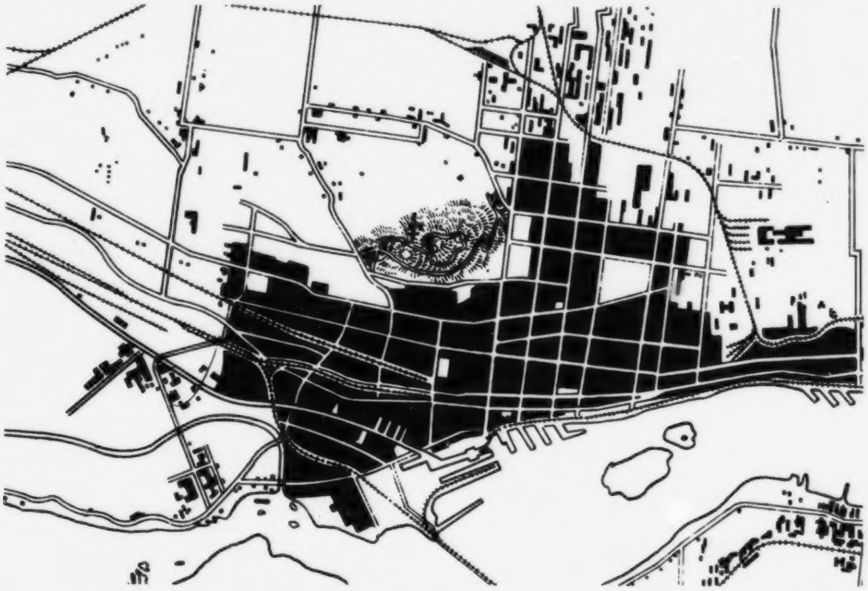


FIGURE 54. Built-up area, Montreal, 1907. Montreal Metropolitan Commission map.

A number of aspects of law and practices applicable to land surveying in Quebec are distinctive to the province. For example, the provincial cadastral system (le cadastre) was ratified in 1864 under authority of articles 2174 and 2175 of the Civil Code.* A prime objective of this system was to provide simplified descriptions of properties. Another principal aim was to facilitate registration of various rights related to ownership of any particular parcel of land. Application of the cadastral system began in November, 1866, and was extended to the Montreal district in the following year. Under the Quebec Surveys Act only a duly licensed surveyor can make valid surveys in the province and prepare plans of properties for public record such as cadastral lots, Crown lands, surveys of power sites, transmission lines and railway right-of-ways.

In the matter of surveying boundary lines of private and public properties the practices followed in the province can best be understood in the light of developments in France at the time of Louis XIV. In that era officials described as Arpenteurs Jurés (Sworn Surveyors) formed a privileged professional body and when a boundary dispute arose between owners of adjoining lands it was mandatory that a Sworn Surveyor be appointed by the disputants or by a court in order that the boundary line might be established with finality. This method and procedure is followed in Quebec.

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*Articles 2166 to 2176c (Civil Code). See ch. 320, R.S.Q., 1941.

Property laws in Quebec are based on the Civil Law of France (Napoleonic Code). One of the more important features of that system of law is that concerned with the establishment of boundary lines or *bornage*. Under the Civil Code of Quebec any land owner can oblige his neighbor to participate in a *bornage*. This is mandatory and a

FIGURE 55. Association of Quebec Land Surveyors in convention on 50th anniversary of incorporation, Quebec City, 1932.

FIGURE 56. Downtown Montreal and waterfront (Jacques Cartier Bridge in background), about 1962.

neighbor may not refuse to cooperate. When accomplished on a friendly basis this survey operation is known as a *"bornage à l'amiable"*. When achieved through the intervention of a court of law it is described as a *"bornage judiciare"*.

When a deed to real estate is drawn up and properly authenticated it remains a documented description of the property. The surveyor is the interpreter of that description, the link between the deed of land and the fixing of the property outlines on the ground. In establishing the *bornage*, all deeds, plans, and other documents bearing upon the history of transactions affecting the properties involved, are assembled and listed by the surveyors concerned. On an appointed day, and at a previously arranged hour and place, the surveyor attends in order to meet both parties to the *bornage* and any other surveyor participating in the proceedings. The documents are duly examined and chainmen are sworn in. After a careful survey of the adjoining properties is completed the survey is tied in to existing landmarks or reference points. A plan of survey is then made for the purpose of easy identification of the lots and this plan is compared with the cadastral plan of the district. If the survey is accepted by both owners, markers are duly placed at each corner of the surveyed property. Then the surveyors draw up a *procès-verbal* of *bornage*, a joint document. By this legal document the *bornage* becomes an official proceeding. It declares the good professional standing of the surveyor and recites the list of deeds examined, plans studied, and details of any survey made in the matter. Finally there is a statement that the document has been duly read by the parties thereto and the accompanying plan or plans approved. Signatures are then attached and the document duly registered.[14]

In the event of a refusal by one or both of the parties to accept the recommended boundary line, it becomes necessary to proceed with a judicial *bornage*. The procedure then followed, requiring the participation of lawyers and of an expert surveyor appointed by the court, is a fairly rigid ritual and rather costly. The expert surveyor makes his own survey independently of the previous one, and prepares his own plan of the line. This plan as well as his report and recommendation are placed in a sealed envelope and forwarded to the custody of the court. The amount of the expert surveyor's fees and expenses are marked on the envelope which is not opened until the indicated amounts have been paid. In most cases the two parties to the dispute agree to half the expense.

Two systems of measurement exist in the province, namely, the French or Paris foot (arpent) and the Standard English foot (acre) and their respective multiples. The French foot is the standard measure of length in Quebec for measuring all land and lots sold prior to 1759 or since granted or sold by the arpent or foot where no special contract to the contrary has been concluded. The English foot is the standard measure of length in the province used in measuring all lands granted by the British Crown where a special contract has been made for that purpose.[15]

French and English Measures

Lineal		
1 pied français	=	1.0657 Eng. feet
18 pieds français	=	1 perche 19.183 Eng. feet
10 perches	=	1 arpent
1 arpent	=	180 pieds français 191.835 Eng. feet
Square		
1 pied carré	=	1.136 sq. Eng. feet
324 pieds carrés	=	1 perche carrée 368.017 sq. Eng. feet
100 perches carrées	=	1 arpent carré
1 arpent	=	32,400 pieds carrés 36,801.7 sq. Eng. feet

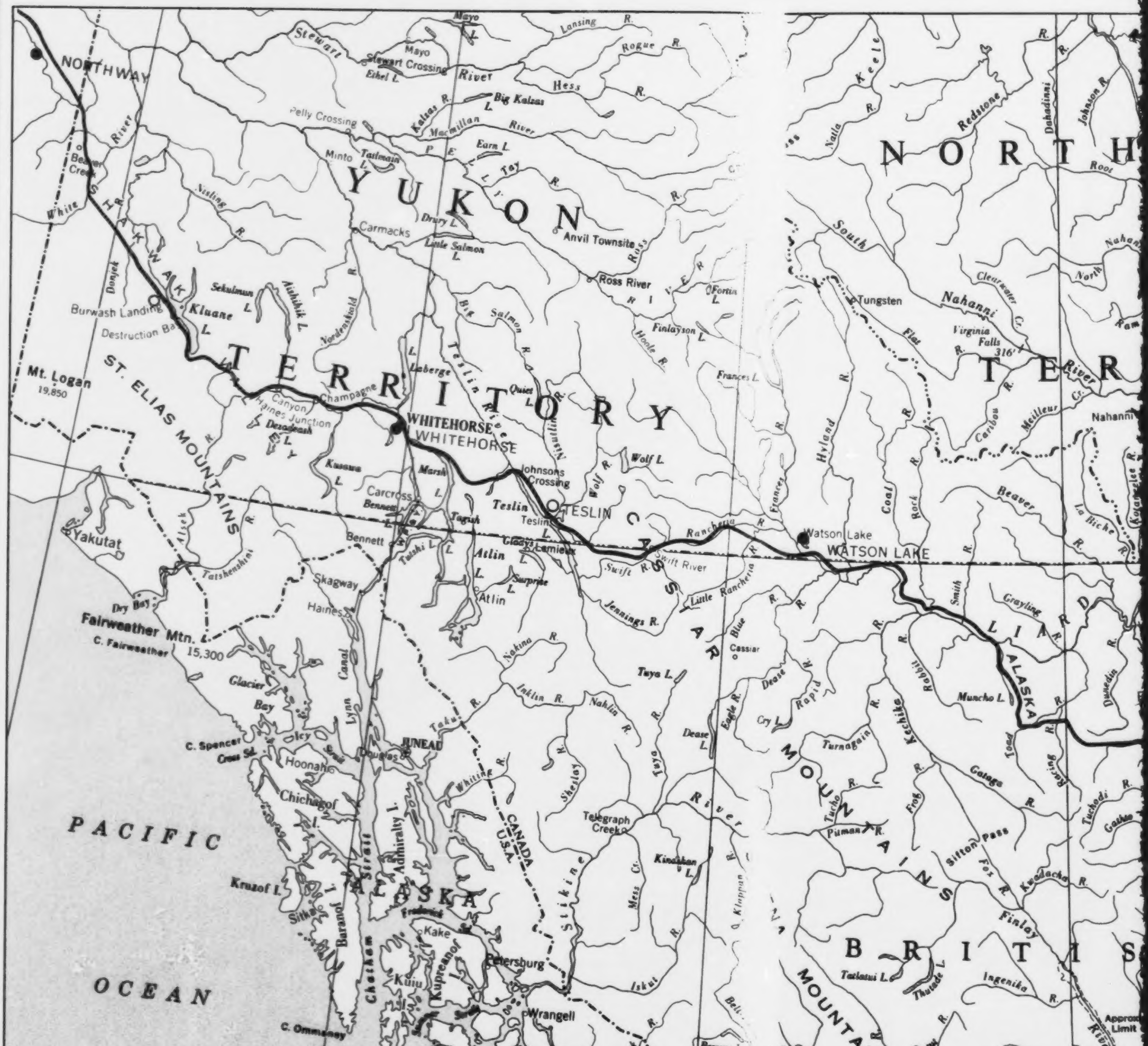
1 acre	=	43,560 Eng. feet
Side of an acre	=	208.71 Eng. feet
1 acre	=	1.184 arpent
1 arpent	=	0.845 acre
1 mile	=	27.52 arpents
1 link	=	7.92 inches
100 links 1 chain	=	66 Eng. feet
80 chains 1 mile	=	5,280 Eng. feet

10 sq. chains = 43,560 sq. feet = 1 acre

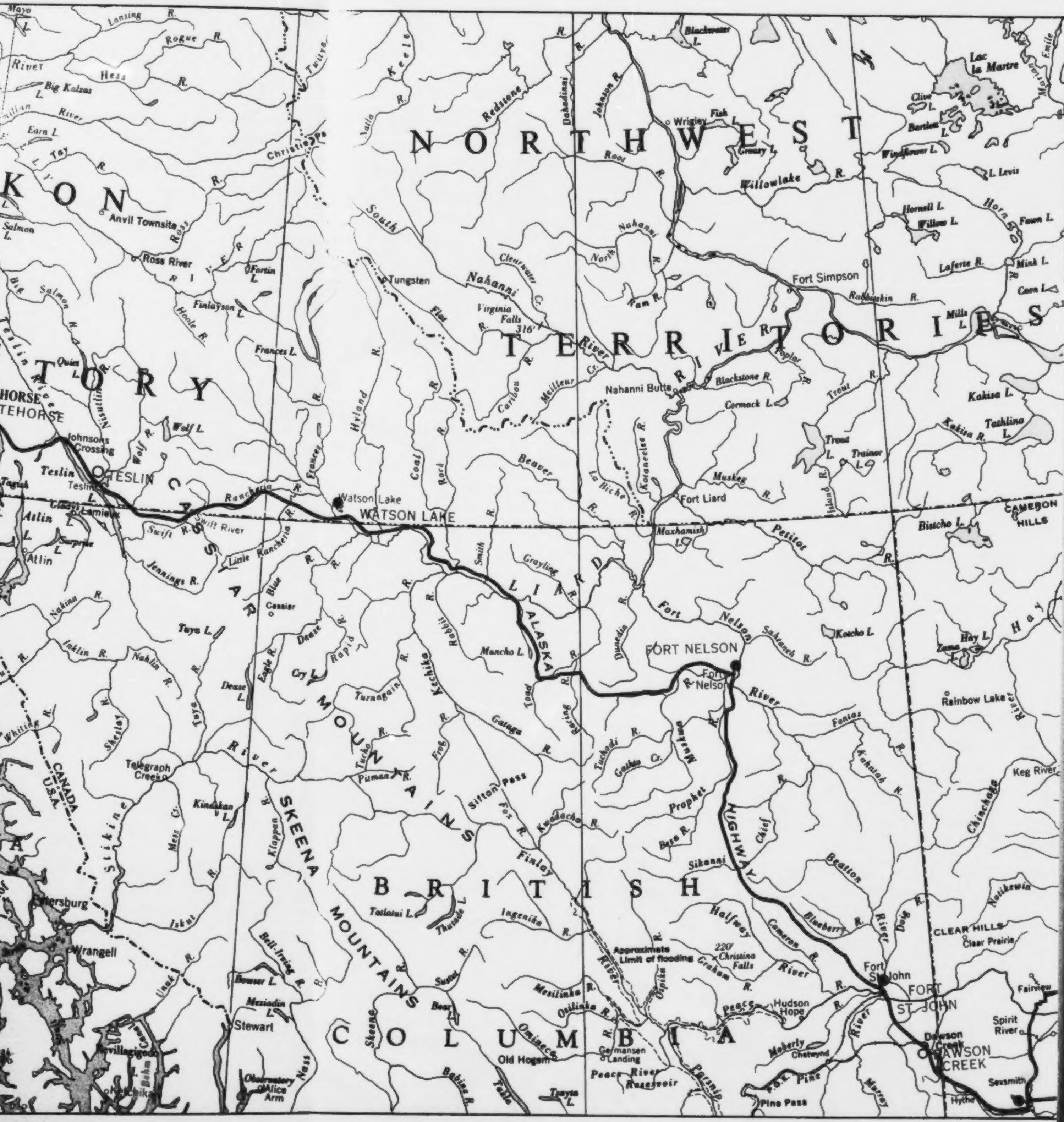
Two other features of surveying law and practice that are distinctive to Quebec province are, first, the "view from the window", and the *mitoyen*-wall or "common wall". Under the Civil Code one cannot have on his property a direct view from a window, porch or balcony, clearly overlooking a neighboring property at a distance of less than six feet, French measure, calculated perpendicularly (about 6 feet, 4¾ inches, English measure). Nor can one have an oblique view from a window or other vantage point which is located in a wall at right angles to the boundary line at a distance of less than two French feet (2 feet, 1⁹⁄₁₆ inches, English measure) from that boundary line. This law has the effect of making possible more effective air space between buildings in urban communities than might otherwise obtain, reducing the impact of nuisances from adjoining premises such as noises and odors.

The Civil Code, under the heading *Servitudes* also provides for the erection and maintenance of a joint or common wall. Any land owner may, under certain conditions, take up to nine inches, French measure, of his neighbor's land on which to build a *mitoyen*-wall.[16] Such a wall must be astride the boundary line between properties, with half of its width on each property. Although the passive neighbor loses the use of that portion of his land he may not use the wall until he has paid half its cost. The advantage gained by this superficially arbitrary provision is that in large cities, such as Montreal, where lots are relatively narrow, one good solid wall between adjoining properties is preferable to the erection of two walls against each other with twice the necessary thickness devoted to the same purpose. The cost of maintenance of the *mitoyen*-wall is common to both property owners.[17]

From these selected examples of "real servitudes" under Quebec law, the special importance of surveying and of surveyors in that province can be readily understood.


NORTHWAY
Beaver Creek
White River
SHAKWAK
Nisling R.
Donjek
Burwash Landing
Destruction Bay
Kluane L.
Sekulmun L.
Aishihik L.
Mt. Logan 19,850
ST. ELIAS MOUNTAINS
Canyon
Haines Junction
Champagne
Dezadeash L.
VALLEY
Kusawa L.
Yakutat
Alsek
Tatshenshini
Dry Bay
Fairweather Mtn. 15,300
C. Fairweather
Glacier Bay
C. Spencer
Cross Sd.
Icy Strait
Hoonah
Chichagof
Kruzof I.
Sitka
Baranof
Chatham Strait
Admiralty I.
ALASKA
Frederick Sd.
Kake
Kuiu
Kupreanof I.
Petersburg
Wrangell
C. Ommaney
C. Decision
Klawak
Revillagigedo I.
Ketchikan
C. Bartolome
PACIFIC OCEAN
Scale : One Inch to 67 Miles
Lynn Canal
Skagway
Haines
JUNEAU
Douglas
Taku R.
Whiting R.
CANADA U.S.A.
Stikine
Mayo L.
Mayo
Stewart River
Stewart Crossing
Ethel L.
Lansing R.
Rogue R.
Hess R.
Big Kalzas L.
Kalzas R.
Macmillan River
Pelly Crossing
Minto
Tatlmain L.
Earn L.
PELLY
Tay R.
YUKON TERRITORY
Carmacks
Drury L.
Little Salmon L.
Anvil Townsite
Ross River
Ross
Fortin L.
Finlayson L.
Hoole R.
Frances L.
Nordenskiold R.
Big Salmon R.
Laberge L.
Teslin River
Quiet L.
Nisutlin R.
WHITEHORSE
Marsh L.
Wolf R.
Wolf L.
Johnsons Crossing
Teslin L.
TESLIN
Carcross
Bennett L.
Tagish
Bennett
Tutshi L.
Atlin L.
Atlin
Gladys L.
Lemieux
Surprise L.
Swift R.
Swift River
Rancheria
Little Rancheria R.
Jennings R.
CASSIAR MOUNTAINS
Frances
Watson Lake
WATSON LAKE
Nakina R.
Inklin R.
Nahlin R.
Teya L.
Tuya R.
Sheslay R.
Telegraph Creek
Mess Cr.
Kinaskan L.
Klappan R.
Iskut R.
Unuk R.
Bowser L.
Meziadin L.
Stewart
Observatory Inlet
Alice Arm
Nass
Bell-Irving R.
Blue R.
Cassiar
Dease R.
Dease L.
Eagle R.
Cry L.
Rapid R.
Turnagain R.
Tucho R.
Pitman R.
Kechika R.
Frog R.
Rabbit R.
Gataga R.
Sifton Pass
Fox R.
Kwadacha R.
Finlay
SKEENA MOUNTAINS
Tatlatui L.
Thutade L.
Sustut R.
Bear L.
Skeena
BRITISH COLUMBIA
Babine R.
Takla L.
Old Hogem
Ingenika R.
Mesilinka R.
Osilinka R.
Omineca R.
Germansen Landing
Tsayta L.
Peace River
Approx. Limit
NORTH TERRITORIES
Keele R.
Natla R.
Redstone R.
Dahadinni R.
Johnson R.
Root R.
South Nahanni
North Nahanni
Tungsten
Flat R.
Clearwater Cr.
Virginia Falls 316'
Ram R.
River
Hyland R.
Coal R.
Rock R.
Caribou R.
Meilleur Cr.
Nahanni
Kotaneelee R.
Beaver R.
La Biche R.
Smith R.
Grayling R.
LIARD
ALASKA
Muncho L.
Toad R.
Racing R.
Dunedin R.
Tuchodi R.
Gathto
R.

MAP 2. Route of the Alaska Highway from Dawson Creek, British Columbia, to Yukon-Alaska boundary.


NORTHWEST TERRITORIES
BRITISH COLUMBIA
KON
TORY
Mayo L.
Lansing R.
Rogue R.
River
Hess R.
Big Kalzas L.
Earn L.
Tay R.
Anvil Townsite
Salmon L.
Ross River
Ross
Fortin L.
Finlayson L.
Hoole R.
Frances L.
Big Salmon R.
Teslin River
Quiet L.
Nisutlin R.
HORSE
TEHORSE
Wolf L.
Wolf R.
Johnsons Crossing
Teslin
TESLIN
Teslin L.
Atlin
Atlin L.
Surprise L.
Rancheria R.
Swift R.
Swift River
Little Rancheria R.
Jennings R.
Frances R.
Watson Lake
WATSON LAKE
CASSIAR MOUNTAINS
Christie Pass
Twitya R.
Keele R.
Natla R.
Redstone R.
Dahadinni R.
Johnson R.
Blackwater L.
Wrigley
Fish L.
Greasy L.
Willowlake R.
Root R.
South Nahanni
Tungsten
Flat R.
Cloarwater Cr.
Virginia Falls 316'
North Nahanni R.
Ram R.
Nahanni River
Hyland R.
Coal R.
Rock R.
Caribou R.
Meilleur Cr.
Nahanni Butte
Blackstone R.
Cormack L.
Kotaneelee R.
La Biche R.
Beaver R.
Fort Liard
Muskeg R.
Trout L.
Trainor L.
Island R.
Trout R.
Poplar R.
Fort Simpson
Rabbitskin R.
Lac la Martre
Clive L.
Bartlett L.
Windflower L.
L. Levis
Hornell L.
Willow L.
Horn R.
Fawn L.
Laferte R.
Mink L.
Cass L.
Mills L.
Kakisa L.
Kakisa R.
Tathlina L.
Bistcho L.
CAMERON HILLS
Petitot R.
Maxhamish L.
Kotcho L.
Hay L.
Zama L.
Hay R.
Rainbow Lake
Keg River
Chinchaga R.
LIARD
ALASKA HIGHWAY
Grayling R.
Smith R.
Muncho L.
Toad R.
Racing R.
Dunedin R.
Fort Nelson R.
FORT NELSON
Fort Nelson
Sahtaneh R.
Fontas R.
Kahntah R.
Tuchodi R.
Gathto Cr.
Muskwa R.
Prophet R.
Besa R.
Sikanni Chief R.
Beatton R.
Chief
Blueberry R.
Doig R.
Notikewin R.
CLEAR HILLS
Clear Prairie
Halfway R.
Cameron R.
220' Christina Falls
Graham R.
Fort St. John
FORT ST. JOHN
Fairview
Spirit River
Dawson Creek
DAWSON CREEK
Sexsmith
Hythe
Hudson Hope
Peace R.
Moberly
Chetwynd
Pine
Pine Pass
Murray
Parsnip
Peace River Reservoir
Germansen Landing
Old Hogem
Omineca R.
Osilinka R.
Mesilinka R.
Ospika R.
Approximate Limit of flooding
Finlay R.
Ingenika R.
Kwadacha R.
Fox R.
Sifton Pass
Gataga R.
Kechika R.
Rabbit R.
Turnagain R.
Pumani R.
Tucho R.
Frog R.
Cry L.
Rapid R.
Dease R.
Dease L.
Cassiar
Blue R.
Eagle R.
Tanzilla R.
Taya L.
Tuya R.
Nahlin R.
Inklin R.
Nakina R.
Sheslay R.
Whiting R.
Telegraph Creek
Stikine River
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Kinaskan L.
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Skeena R.
Babine R.
Takla L.
Tsayta L.
Iskut R.
Bell-Irving R.
Bowser L.
Meziadin L.
Nass R.
Stewart
Observatory Inlet
Alice Arm
Unuk R.
CANADA
U.S.A.
Petersburg
Wrangell
Revillagigedo
Behm Canal
Ketchikan

MAP 2. Route of the Alaska Highway from Dawson Creek, British Columbia, to Yukon-Alaska boundary.

6

ALCAN AND CANOL: THE SURVEYS STORY

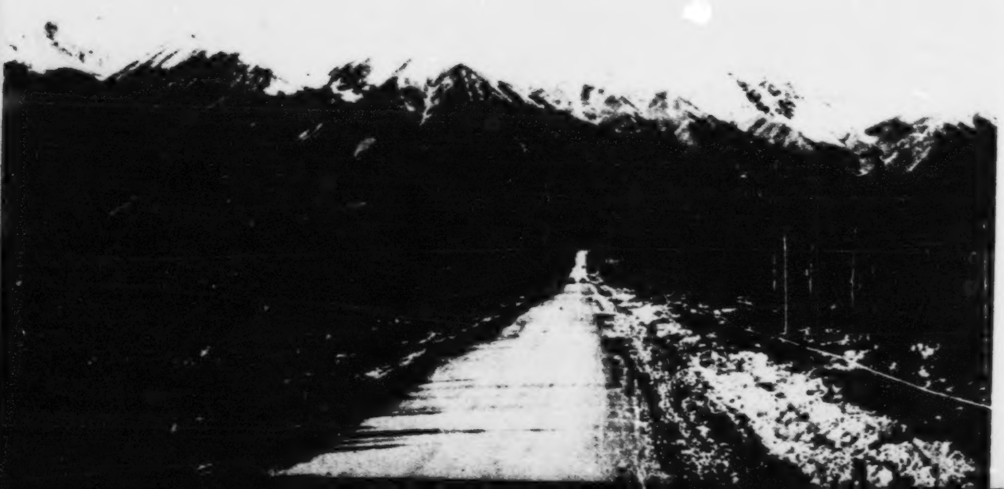
The Alaska Highway, the pilot road of which was undertaken and completed wholly in 1942, must be counted among the truly superlative feats of engineering performed on the continent of North America. The pioneer road, 1,523 miles in length, linked Fairbanks, Alaska, with the British Columbia community of Dawson Creek, some 500 miles northwest of Edmonton, Alberta. This unique highway project, the concept of which was described by one early critic as "an engineering monstrosity impossible of completion" was built in little more than eight months of arduous, unceasing labor and at a cost estimated at about $135,000,000.[1] Most of the road, some 1,221 miles, lies in Canadian territory. Although much of the credit for the location and construction work belongs to units of the United States Army Engineers and to contractors and workers employed by and through the United States Public Roads Administration, nevertheless individual Canadians, including surveyors and mappers, made vitally important contributions to the advancement of the project in preliminary stages of its construction. In addition, Canadian government military and civilian organizations became wholly responsible for post-war maintenance and improvements of the right-of-way, tasks calling for extensive surveying activity.

At the outset this road project was officially described as the Alaska-Canada Highway, conveniently shortened on occasions to Alcan Highway, then commonly and finally known as the Alaska Highway. The Canadian portion of the highway cuts across the northeastern corner of British Columbia and, in a general way, follows the British Columbia-Yukon boundary as far as Teslin Lake. From there it heads into Whitehorse, Yukon Territory, and, after skirting the west shore of Kluane Lake, reaches Snag on the Yukon-Alaska border. If a highway of similar mileage had been built from, say, east Florida in the same general direction as the northern road, it would have reached into Kansas. Seven engineer regiments of the U.S. Army, comprising nearly 400 officers and upwards of 11,000 enlisted men, worked on the Alcan project, aided by about 50 contracting firms employing more than 7,500 men. At least 130 bridges, several of them of major proportions, were built in addition to thousands of culverts.

The idea of an overland road link between the continental United States and Alaska was first conceived during a period of peace. In 1928 a location engineer, Donald MacDonald of Fairbanks, enthusiastically campaigned on behalf of this plan. As early as 1930 recognition of the desirability of such an undertaking was expressed in official actions by the governments of the United States and of Canada.[2] In that year, under the terms of Bill H.R. 8368, the President of the United States was authorized to designate three special commissioners to cooperate with representatives of Canada in a feasibility study of a highway to Alaska. Three Canadian representatives, headed by Hon. George Black, were named but, owing to depressed economic conditions in both countries, no action to implement these studies was taken. The idea of such a highway was revived in 1938 when the Alaskan International Highway Commission was appointed by the President. This was a five-man body and, later in the same year, its counterpart was established in Canada, headed by Hon. Charles Stewart. These two commissions jointly and severally carried out investigations of various proposed routes up to and shortly after the United States' entry into the Second World War. In the meanwhile the United States House Committee on Roads studied and reported on various bills proposing highway links with Alaska in 1930, 1935, 1938 and 1940.[3] The Canadian commissioners flew over much of northern British Columbia and recommended alternative routes, one through Prince George to Whitehorse and Dawson City, another through Prince George to Watson Lake by way of Pelly Crossing.[4]

During the relatively unhurried pre-war days of cautious probing and careful deliberation it was assumed that the location of such a highway would be determined, in the final analysis, by balancing its advantages against initial costs and subsequent maintenance charges. Its principal benefits would include usefulness as a defence measure as well as a developer of mineral resources and of tourist traffic. It was conceded that elevations, and depth of snowfall, would be factors having an important bearing upon the final decision on location. It was felt that consideration ought to be given to the availability of possible airfield sites along the route. The government of British Columbia had arranged

FIGURE 57. View of the Alaska Highway near Kaidern River, Yukon. Kluane Range is in background.



for the scouting of three likely routes but it favored the Rocky Mountain Trench route by way of Prince George.[5] This route, of the three examined, had the lightest average snowfall, the longest open season, the shortest total distance to destination and, since it possessed the best grades and alignment, consequently the lowest construction and maintenance costs.

In the meantime, under civilian auspices, an unpublicized but portentous air probe had taken place in northwestern Canada. The findings of this investigation resulted, in time, in the rejection of all routes to Alaska previously under serious consideration. In the summer of 1935 the then Acting Superintendent of Airways and Airports, Alexander Daniel McLean (1896-1969), along with the enterprising Canadian bush pilot, C. H. "Punch" Dickens, D.F.C., flew on an aerial reconnaissance survey across northern Alberta, the Northwest Territories, Yukon Territory, and northern British Columbia. At that time air transport officials at Ottawa were planning for the long future in the realm of international airlines and had decided to seek out the shortest and best airway across northwestern Canada to Siberia and thence to China. In the latter stages of this far-ranging investigation McLean and his pilot were accompanied by Dr. Charles Camsell, Deputy Minister of Mines and Resources, whose knowledge of the Canadian North was intimate, extensive and highly respected. W. Sunderland, a flight engineer on this reconnaissance mission, served also as a cameraman and, in this latter capacity, had the responsibility of providing a pictorial record of the trip. In effect McLean's findings transformed the Edmonton-to-Dawson Creek-to-Fairbanks route into a road of destiny.

FIGURE 58. A. D. McLean.

Before his epochal flight McLean had consulted a large map of North America. Using Chicago as his principal cartographic base he had drawn lines on the map indicative of great-circle routes eastward to Europe and westward to Asia. His great-circle route to the west was a line running through Winnipeg, Manitoba, Fort Smith, N.W.T., and Fairbanks, Alaska, a point close to the Arctic Circle.

McLean's final report to Ottawa was succinct and conclusive. He pointed out the defects, as he saw them, in the Winnipeg-Fort Smith route. "In comparison", he stated, "the route from Peace River to Whitehorse by way of the valley of the Liard closely approximates the true great-circle route and greatly shortens the distance through which it would be necessary to develop an airway through virgin territory." McLean expressed the view that this latter venture was feasible and that, in his judgment, "there would be no section which, after development, would be inaccessible at any time of the year."[6] Sorties by air into the Liard country had been confined, up to that time, to occasional transportation of prospectors and trappers. Stan McMillan of Edmonton was a noted bush pilot who made a number of flights of this nature into that largely unknown part of Canada.

In the course of the year preceding the McLean probe and report, the possibility of establishing an airmail service on a regular basis between Edmonton and the Yukon had been scouted by two other Canadian bush pilots, Ted Field and Grant McConachie. The latter flier, years later, became president of Canadian Pacific Airlines. These two trailblazers of the air, flying Fokker Universal aircraft, carried out this reconnaissance at the request of the government at Ottawa. They promptly organized a company, United Air Transport, later the Yukon Southern Air Transport and, in 1937, the Post Office Department awarded them the mail-carrying contract between Edmonton and Whitehorse on a weekly basis. The frequency of this service gradually increased until, in 1940, it was on a daily basis.

These regular mail flights were carried on, in the absence of intermediate airfields, by means of pontoons in summer months and skis in the winter period. Both McLean and his Ottawa chief, J. A. Wilson, Controller of Civil Aviation, made trips with McConachie over the airmail route during this period. Its suitability as an airway to Alaska and, eventually, Asia, was amply demonstrated to Wilson, and approved by him at that time. It should be borne in mind that at this stage in the history of aviation generally, there were no high-altitude aircraft in use; very little, if any, flying by instruments and, apart from Lindbergh's epochal Atlantic crossing and several other extraordinary individual or dual exploits, no trans-ocean flights. Thus, even across the land mass of northwestern Canada the need for a system of intermediate airfields between Edmonton and Fairbanks was obvious if that route was to be, in fact as well as in fancy, a "Northwest Passage" by air to Asia. In the spring of 1939 a survey of the proposed airway was authorized by the government at Ottawa. The precise location of airfield sites and related detailed contour surveys were carried out by W. L. Lawson and R. Crossley. Landing strips suitable for extension and each served by a radio range station were installed.[7] The knowledge that these landing fields had been planned and surveyed, and were in varying degrees of readiness for full use, undoubtedly weighed the balance in favor of the Northwest Staging Route when the final decision for the location of the Alcan Highway had to be taken.

On the ground between the airfields there had been other helpful developments. As early as 1922 parties of the Topographical Survey of Canada had cut a pioneer sleigh trail from Fort St. John to a winter station called Horsetrack on the Sikanni Chief

River, a point from which trade goods were customarily scowed downstream in the springtime to Fort Nelson.[8] Philip H. Godsell, explorer in the Canadian northland, has claimed that he blazed a trail between these same two points in 1925.[9] In any event the Department of Transport, early in 1941, widened the trail by using bulldozers and extended it to the site of the newly-established Fort Nelson airfield as a winter road. The only other important roadway along the entire Northwest Staging Route in Canada was a 160-mile wagon road that had been opened from Whitehorse to Kluane Lake. This latter facility proved highly useful as an access road in preliminary stages of Alaska Highway construction.

In the depression period of the early 1930s, when surveying activity throughout Canada was generally at low ebb, the Dominion land surveyor, Knox Freeman McCusker (1890-1955) and a companion, Glen Minaker, acted as guides in northern British Columbia for hunting parties organized by wealthy Americans. In 1935 such a venture took them from Fort St. John to the Pacific Ocean by way of McDame Creek. When they returned to their winter camp that autumn the Canadians read newspaper references to a proposed highway serving to connect Alaska with the continental United States. Stimulated by these reports the two men busied themselves during the off-season by locating on paper a more or less feasible route extending in part as far as Lower Post, B.C., just across the boundary from Watson Lake in the Yukon. McCusker, over the years, had gathered considerable information from Indians of the region concerning the nature of the country between Lower Post and Whitehorse. All this knowledge, which he had accumulated as a guide in the northland, was incorporated in the rough-drawn map. McCusker and his friend little realized that, seven years later, this map would prove to be exceedingly useful in promoting an important strategic enterprise of the free world in a deadly conflict of global scope.

It was during this period of economic depression that one of the strangest overland expeditions ever to venture into the Canadian North West originated in Edmonton in July, 1934. The highly implausible cavalcade that was organized and financed that year by the French multimillionaire, Charles Eugene Bedaux, was formed ostensibly for exploration purposes. It consisted, in transport equipment, of two shiny new limousines, five Citroen tractors and some 130 horses loaded with gasoline tins. The core group of the expedition was composed of Bedaux and his valet; two refined ladies from the gracious, elegant salons of Western Europe; Madame Bedaux and her friend, Madame Chiesa, along with a maid-in-waiting and, on the more practical side, two British Columbians well-versed in the lore of the northern wilds, the Dominion land surveyors Frank Cyril Swannell (1880-   ) and Ernest Charles William Lamarque. The announced destination of the Bedaux expedition was Telegraph Creek, B.C., on the upper Stikine River.[10] The expedition left Edmonton on July 6, 1934.

Although Swannell was expected to render services to the expedition as a mapper, it soon became obvious that Bedaux's interest in cartography was, to say the least, desultory. When Swannell was ordered at one point on the route to abandon nearly 100 pounds of surveying equipment, he felt confirmed in his earlier suspicions that the expedition was more in the nature of a publicity stunt than a serious scientific probe into an unchartered wilderness. With the sudden dismissal of the expedition's radio operator, Swannell was deprived of the use of Greenwich time signals for position-fixing purposes. The forward advance of the party was constantly hampered by wastage of time, stores and equipment as well as the loss of many horses. The Muskwa River was reached on the last day of August but, with colder weather rapidly approaching, Bedaux gave

FIGURE 59
F. C. Swannell.

instructions to turn back at Sifton Pass, some 200 miles short of their announced goal. By the end of October, 1934, the expedition had come to an inglorious end. It had cost its wealthy sponsor about a quarter of a million dollars and, in the process, provided a stream of sensational news despatches that had regaled the reading public in many nations at a time when extravagant distractions were at a minimum.

The bizarre venture, however, was not a complete loss from a practical standpoint. Experience in the use of tractors in the hinterland of northern British Columbia revealed the severity of conditions under which modern roadbuilding machinery could be expected to operate should the construction of a major highway be attempted in that part of Canada. The cross-country progress of the Bedaux expedition also added somewhat to general knowledge of the region it traversed. It is significant to the theme of this chapter that Bedaux remarked on the dispersal of his cavalcade, "a start has been made on a highway to Alaska."

During 1940, as diplomatic relations between Japan and the United States deteriorated, tension between the two great powers began to mount in the Pacific area. The fact that Alaska, in all North America, offered the mainland target most vulnerable to attack from Asia, caused increasing concern in Washington, D.C. In August, 1940, under the Ogdensburg Agreement, the United States-Canada Permanent Joint Board of Defence was established. Provision for the movement of American warplanes across western Canada to Alaska, and possibly to the Soviet Union, was considered imperative. In November of that year, in Victoria, B.C., the board recommended construction of a line of airfields from Fort St. John to Fairbanks, soon to become generally known as the Northwest Staging Route.

Meanwhile, in 1939, Canadian authorities had authorized, as has been noted, a more detailed survey of this airway project, including location of airfields at Grande Prairie, Fort St. John, Fort Nelson, Watson Lake and Whitehorse. Later, intermediate fields were to be added at Beatton River (between Fort St. John and Fort Nelson), Smith River (between Fort Nelson and Watson Lake) and Snag Creek (between Whitehorse and Fairbanks). An Edmonton construction firm awarded the airport-building contract at Fort Nelson, ingeniously put together a diesel trailbuilder train that chugged out of Dawson Creek and headed northward on February 9, 1941, over the existing rough winter trail. In April and May surveyors were busily engaged at Fort Nelson laying out runways and setting grade stakes. One year later United States forces were to travel over this same winter trail during the first stages in the building of the Alaska Highway.

FIGURE 60. Typical scene on the pioneer winter trail between Fort St. John and Fort Nelson.

During the spring and summer of 1941 McCusker and his associates in the packing business aided the Department of Transport in the freighting of heavy equipment and supplies to the Fort Nelson airfield by employing scows on the Sikanni Chief River. In the following winter nearly 1,500,000 gallons of aeroplane gas and motor fuel in drums were conveyed to that field. The primitive road was so bumpy in places that occasionally a barrel would jump clear of a truck. A missing drum lay for weeks beside a rivulet known as Buck Creek. One day a plane, operated by a construction official, left Whitehorse for Fort Nelson. Unable to land at its destination because of poor visibility, it continued in flight. With fuel running low and perceiving a fairly level strip of ground the pilot decided that this was the most suitable available place in the wilderness on which to make an emergency landing. Safely down, the official left his plane to take stock of his surroundings and noticed a small patch of red on the snow a short distance away. Upon closer investigation the object proved to be a drum of aeroplane gas, the same barrel that had been bounced out of the supply truck. In the whole of that vast, unpeopled region this pilot had selected, by sheer coincidence, the only landing place equipped with fuel for his plane!

A Vancouver construction firm was awarded the Watson Lake airfield-building contract and began freighting loads upstream on the Stikine River after the spring break-up, the first loads arriving on site on July 9, 1941. Thus, by December, 1941, on the entry of the United States into the Second World War, an airway remote from enemy attacks, equipped with what was then up-to-date air navigation aids and at least rudimentary lighting facilities, had been established by Canadians between Edmonton and the Yukon-Alaska boundary. In 1942 the United States was to spend many millions of dollars improving the airfields along the staging route and installing more than a dozen intermediate landing strips.

The highly destructive Japanese attack on Pearl Harbor, Hawaii, in December, 1941, and the crippling loss to the British fleet soon afterwards through the sinking of two of its major battleships, *Prince of Wales* and *Repulse*, in Far Eastern waters, drastically altered the balance of naval power in the Pacific Ocean. The entire situation in that vast area, from the standpoint of the free world, was enveloped in an atmosphere of extreme urgency. Often wars act as catalysts, bringing into being immense projects which, in peacetime, appeared to be far beyond early realization. Thus, in regard to the Alaska Highway proposal, political and bureaucratic wheels began to turn with increasing rapidity. On January 16, 1942, immediately following a strong appeal in Congress by Delegate Dimond of Alaska for action on the road, a committee of three members of the American cabinet was appointed by President Roosevelt to meet the War Plans Division of the Army General Staff and to discuss the ways in which Alaska could best be defended. This committee was soon convinced that a highway linking the continental United States with Alaska, along a route reasonably remote from enemy onslaughts yet capable of ferrying planes, troops and supplies on a large scale, was vitally essential. The water route along the Pacific Coast, exposed to activities of Japanese submarines, had become hazardous. Late in February, 1942, the joint board on defence authorized the undertaking, and formal agreement of the two national governments directly concerned was embodied in an exchange of notes between Ottawa and Washington in mid-March. The agreement provided for the construction of a major highway from Dawson Creek, British Columbia, to connect existing airfields between that point and Fairbanks. There had been strong arguments, vigorously advanced, in favor of other possible routes and had a decision on the various choices been made during peacetime it is quite likely that one of the alternative routes would have been selected. But investment in existing airfield construction together with the expert opinion of United States army engineers that such a connecting highway could be built over the Northwest Staging Route within the time limit set for its completion, outweighed all other factors. Speed of construction and considerations of a completely military character had become suddenly paramount.

A trail investigation group from the United States arrived at Sikanni Chief River early in 1942 and consulted with McCusker and others whose first-hand knowledge of that part of Canada's northland was both well-known and widely respected. McCusker assured the group that if advance units of roadbuilders could be in position at Fort St. John by mid-March he would guide them in location work for a pilot road across some 500 miles of hinterland before the spring break-up. Within three weeks of this preliminary discussion McCusker's offer was accepted officially and the Canadian land surveyor was soon fully occupied in organizing outfits able to guide American engineers across country from Fort St. John to Toad River for the purpose of confirming on the ground the findings of aerial surveys of the region, involving the stereoscopic examination of air

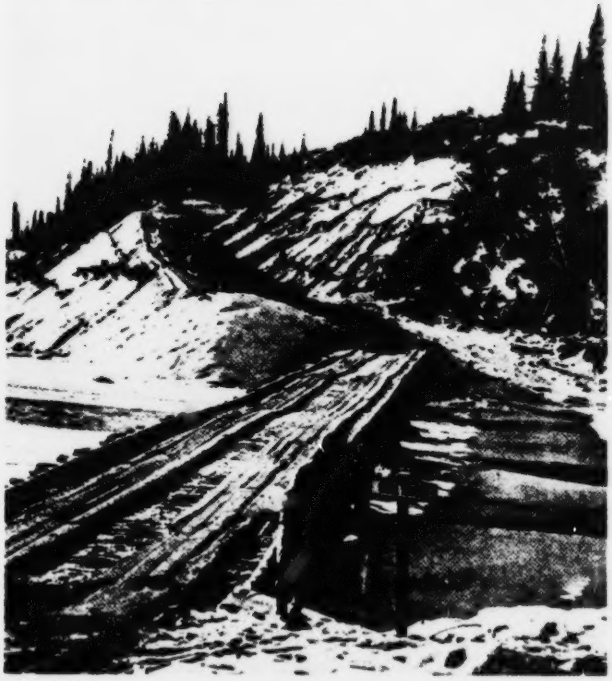


FIGURE 61
Typical temporary bridge on pioneer trail of the Alaska Highway.

photographs. By the employment of several dog teams on separate missions, reconnaissance was accomplished of some 450 miles of possible route within a month.[11] In the main, the scouted line followed closely the route sketched by McCusker for his own satisfaction seven years previously.

The awesome vistas and ancient ways of life of the north country had seemed unchangeable. High over the mountain peaks, planes shuttled over dark forests and deep canyons where the roar of mountain streams and wolf howls echoed weirdly. Moose still came to lake's edge to drink at dusk. Trappers continued to set snares for the wary fox. Bears ambled forth after a long winter's sleep and in the late springtime fattened on wild berries and fish. Canoes slipped noiselessly along watercourses, summer highways in the wilderness. In winter, dog trains followed trails which ran straight as an arrow's flight over hill and dale. But a startling change was near. Silent forests would soon resound to the snarl of the power saw and the mechanical snorts of bulldozers and caterpillar tractors. The end of the quiet hinterland was at hand; myriads of men were on the march and this scarcely trodden wilderness was their battleground.

By mid-March soldiers, machinery, and supplies began to arrive at Dawson Creek, the end of steel. Engineers commenced to travel up the trail toward Fort Nelson. Astonishing roadbuilding developments followed in rapid succession. A highway survey between Dawson Creek and Fort St. John was completed for the purpose of improving the existing road to accommodate the anticipated heavy traffic. Word went through the northland by 'moccasin telegraph' calling all pack-horse train operators (packers) into action. From the hills and valleys came the Napoleons, Calahoos, Beattons, Belcourts, Letendres, Campbells and Camerons, along with Cree and Beaver Indians and a total of about 400 horses. The age of the packers had suddenly returned to the northland.

McCusker, in his unpublished memoirs, described the customary highway construction procedure followed in conquering the hinterland. Two men, guided by McCusker, blazed the initial trail. The Canadian, who plodded ahead on foot, kept waving the pair onward. After them came the stadia survey party who ran the preliminary line and cut a pack trail of sorts for the use of advance transport. The surveyors were closely followed by a single bulldozer, busily opening a narrow swath through tree growth along the stadia or centre line so that other bulldozers, in squads of six, could operate on a larger scale. Three large bulldozers felled big trees and three smaller machines cleaned up resulting debris. This clearing operation made way for rough as well as finished grading work, installation of culverts and of small bridges. During this stage an Indian, travelling along the old packhorse trail from the direction opposite to that of the advancing Americans, remained blissfully unaware of the brutal, crashing advent of 'civilization' into his placid, lonely domain. Suddenly he came upon a caterpillar tractor, operated by a negro soldier, at a moment when the cat had casually tossed several sizable trees high into the air. The Indian, it is related, left the scene and tarried not in the leaving. When at last he reached a trading post the native gasped out the obscure but somehow terrifying message, "Big black devil him come!"[12]

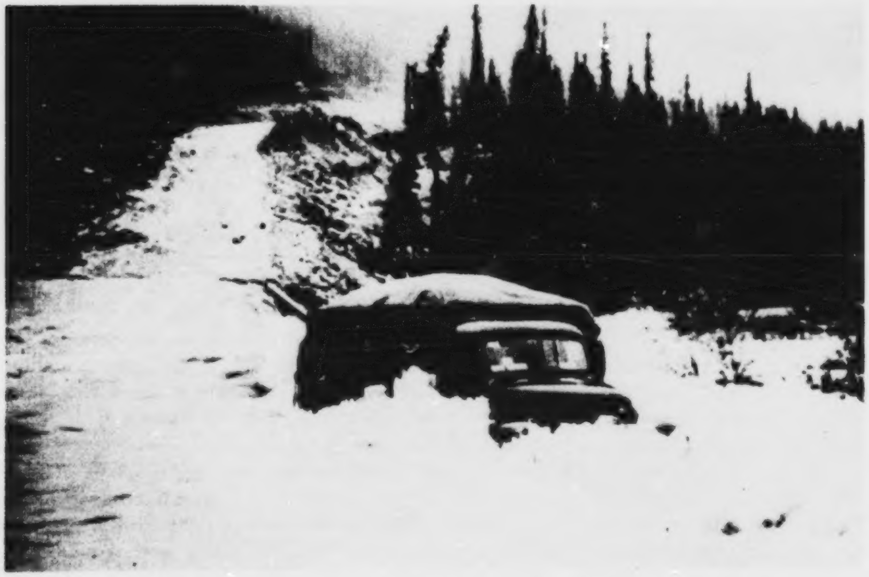


FIGURE 62. Army truck fording a stream in flood during survey reconnaissance along the Alaska Highway.

After the cats had levelled the roadway for grading, subsequent parties located the final route, building corduroy road and culverts when required. Pack trains threaded their way gingerly through tangles of tractors, graders and toiling men. Radio equipment enabled workers to keep in close, constant touch with developments all along the regional line of construction. In this manner the pilot road of the Alaska Highway was pushed through forests of stately evergreens, across swift-flowing rivers and streams, over mountain passes, and alongside shimmering lakes and brooding glaciers, old as time.

The story of hardships and discomforts endured cheerfully, if cussingly, by these indefatigable roadbuilders, spurred on by inter-regimental rivalry, will never be fully told. "We were soon to find out," wryly commented one engineer, "that each of us had muscles we had not previously known about." Again, "Mushers ahead left a piece of bannock and a can of grapefruit juice at the side of the trail. The bannock was cold and the grapefruit was frozen."[13] This was hardly the sort of fare to revive hungry, cold and tired men laboring through the unfriendly bush. Voracious mosquitoes and flies, dust in billowing clouds, sub-zero temperatures and bone-chilling, sleety rains frequently

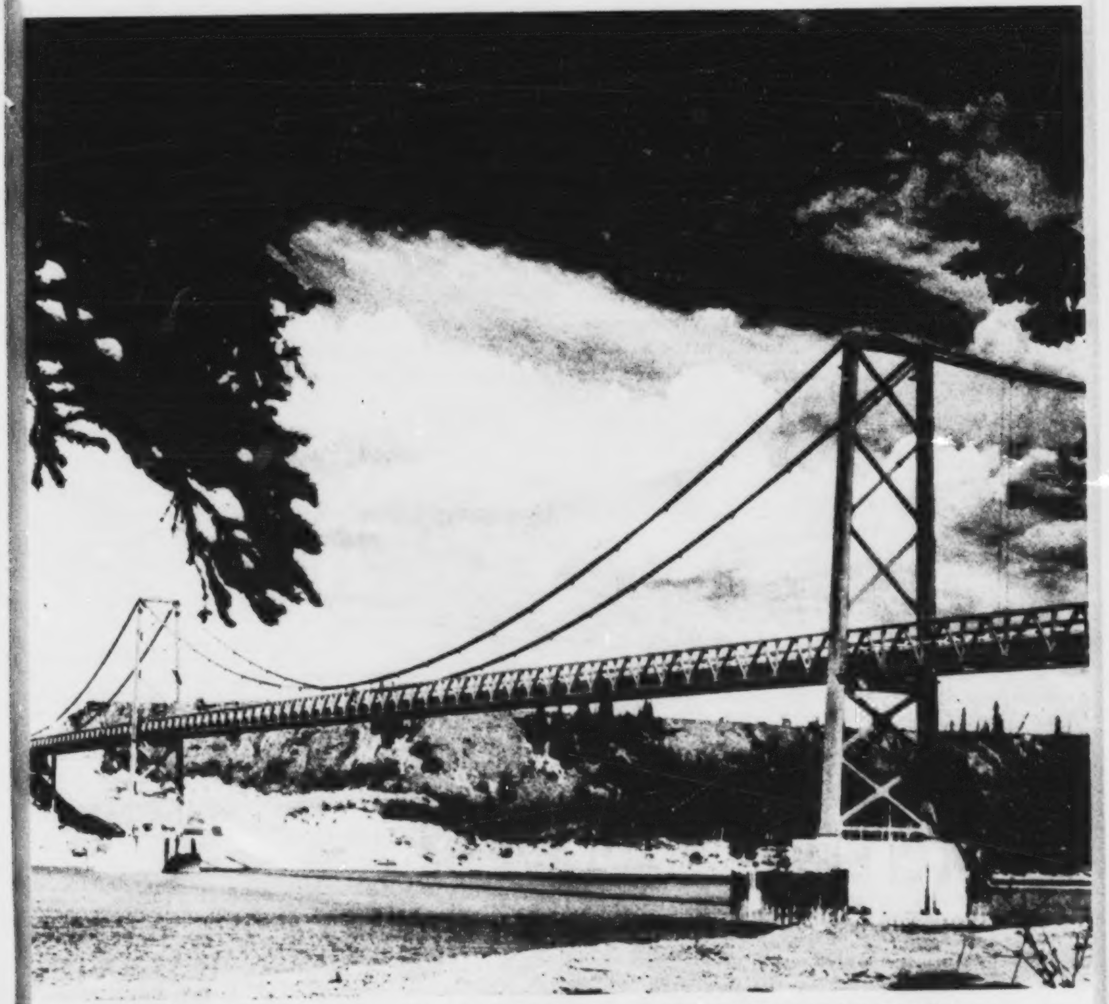


FIGURE 63. The original Peace River bridge. Erected 1942, partly collapsed in 1957 and replaced in 1960.

made life miserable for human beings and animals alike. In addition, the baffling problems of deep-penetrating permafrost, jelly-like muskeg, and swampy lowlands had to be faced and solved in a hurry.

The initial drive to reach Fort Nelson with vehicles and supplies proved to be a stamina-testing race against the advent of the spring break-up. Men worked in extremely long shifts and motor engines were seldom turned off. A false thaw set in at one stage of the work. Men and machinery floundered in a sea of soft mud. River ice began to heave. Suddenly, Fort Nelson seemed unattainable. But just as hope was fading 'General Frost' came to the rescue of the toiling troops. Muskeg again froze over, cracks in river ice filled in. During those few days of grace, extending almost to mid-April, hundreds of trucks freighted in to the airfield mammoth loads of supplies required for its improvement. The trucks were kept moving night and day during this critical period. A pilot who flew over the busy scene one night reported, "the stretch of road into Fort Nelson looked like Broadway. It seemed to be lit up all the way with the headlights of trucks."[14] Often the ubiquitous jeep, that tireless workhorse with its narrow wheelbase, powerful engine and four-wheel drive, covered with ease ground that was so difficult to cross that heavier, less versatile vehicles bogged down completely.

Official assistance to the American roadbuilders was not entirely provided, on behalf of Canada, through the good offices of the federal government. Prior to the entry of the United States in the Second World War Ontario had developed, through its provincial government services, a system employing air photographs by which it was possible to locate on the ground lines of proposed new highways. After selection of the most acceptable route on the basis of planimetric data, topography along the projected line was checked for grades and surface conditions through examination of stereoscopic photo pairs. This procedure entailed the services of an examiner experienced in photo-interpretation. Information produced by orienting and scaling the photographs into mosaic form often resulted in major revisions of the line first chosen.

The Alaska Highway construction authorities, aware of Ontario's progress in this special field, asked for the services of Ontario government officials directly involved. R. N. Johnston, in charge of aerial surveys for the Department of Lands and Forests, and K. H. Siddall, chief location engineer for the Department of Highways, arrived at Fort St. John in June, 1942, and were at once attached to the Southern Sector Task Force.[15]

By the use of air photographs much faster progress was made on the establishment of a line of highway than would have been possible without them. By the use of air transport, survey parties had moved rapidly and easily to points along the entire line of proposed road. Location work, accordingly, was greatly simplified and accelerated. Without any doubt the highway could not have been built so swiftly without the facilities provided by the airway system already established through the foresight and wise action of Canadian leaders. As it was, all road construction records were surpassed when the highway between Dawson Creek and Fairbanks was completed.

On November 20, 1942, in 30-below zero weather, the official road-opening ceremony took place at Soldiers' Summit overlooking Kluane Lake. After the red, white and blue ribbon was cut, a convoy of trucks left for Fairbanks, the first vehicles to travel over the highway from Dawson Creek to the Alaska terminal. Ten thousand soldiers divided into seven army engineer regiments, aided by 8,000 civilian workmen had completed their task in record time. They had pushed forward at the rate of eight miles a day, bridged 200 streams and rivers, laying a roadway 24 feet between ditches. The highest point on the highway, 4,212 feet above sea level, occurred between Fort Nelson and Watson Lake.

With the completion of the Alaska Highway the long isolation of northwestern Canada from the rest of the world was brought to an abrupt end. Although the immediate purpose of the road was to serve urgent military needs, its potentialities for promoting peacetime development of Canada's renewable and non-renewable natural resources as well as tourist traffic in that part of the nation, were implicit in the project. Moreover the Northwest Passage to the doorstep of Asia, for several centuries the dream of men of enterprise and vision, had become a reality by air and by highway in the 1940s in Canada.

The Canol Project

At about the time that the Alaska Highway was launched to follow along the line of the Northwest Staging Route, another northern engineering enterprise of major proportions began to take shape in the minds of American military authorities. They became convinced, as Japanese aggression continued in the Pacific area, that a reliable supply of oil for aircraft and mechanized ground units engaged in defence operations in Alaska was urgently required. In the light of all factors obtained at the time the sensible solution to this problem appeared to be the construction of a pipeline from the modest but still active oil field discovered and developed in the early 1920s by Imperial Oil Company of Canada in the vicinity of Fort Norman. This field was located on the banks of the Mackenzie River near the 65th parallel of north latitude. The plan called for the transportation by pipeline of the crude oil to a refinery to be constructed at Whitehorse, from which point the gasoline could then be shipped to points in Alaska.

The direct airline distance from Whitehorse to Norman Wells is about 425 miles but a pipeline overland between these two places would extend to nearly 550 miles. In addition an all-season highway would have to be constructed along the entire route of the pipeline in order to expedite its construction and any servicing involved in its use. The roadway would govern grades along the course of the project, not the pipeline. Pipe could be laid on the surface of the ground except at river or stream crossings where pipe could be either buried or suspended.

Late in April, 1942, Canadian officials of Imperial Oil Limited were invited to Washington in order to discuss with army authorities there the proposal that came to be known as the Canol (Canadian Oil) Project. In June of that year official notes were exchanged between Ottawa and Washington embodying agreement of the two governments on principal features of the proposal. Again the need arose to achieve maximum results during the relatively short construction season in the Canadian North; a race of men and machines against the hostile elements. One of the first steps to be taken was the establishment of a line of airfields between Edmonton and Norman Wells in order to speed the movement northward of Canol personnel, supplies, and equipment. Most Canadian flying in the northland, down the Mackenzie, had until this time been accomplished in planes using skis in winter and pontoons in summer.

In the region between Whitehorse and Norman Wells careful reconnaissance survey work was essential. This was a largely untravelled wilderness, formidable and even forbidding to all but the most zealous explorers. On the horizon west of Fort Norman and nearby Norman Wells were the peaks of the Mackenzie range, described in Père Pettitot's

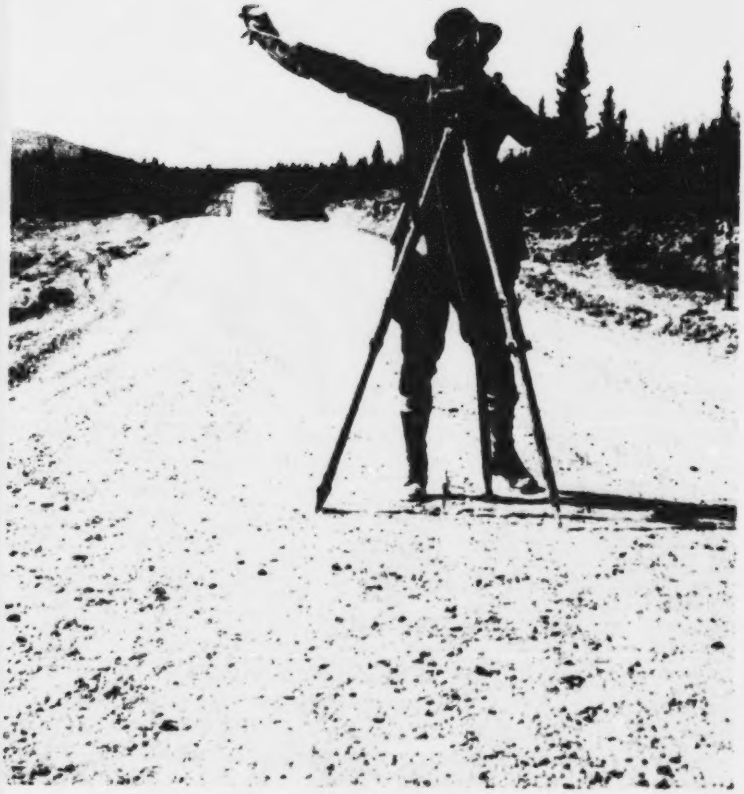


FIGURE 64
Surveys on the Alaska Highway at junction of pilot road and the permanent highway.

map of 1875 as "the backbone of the earth."[16] But a certain amount of authoritative information on the country between this range and Whitehorse was available as a result of a pioneer reconnaissance made in the region by Joseph Keele (1863-1923) of the field staff of the Geological Survey of Canada in the seasons of 1907 and 1908.[17] Keele investigated with characteristic care the areas drained by the Pelly, Ross, and Gravel rivers and his 54-page report on a variety of aspects of the region, was issued in 1910 as a government publication separate from references on the same subject in annual summary reports of the Geological Survey of Canada. A map of the country he had explored formed a supplement to his report.

As Keele was no longer alive the American authorities, in this time of special need, turned to a man possessing extensive, first-hand experience of the Canadian North West, the Ottawa-born Dominion land surveyor, Guy Houghton Blanchet (1884-1966). In early discussions of problems involved in the Canol Project the decision had been reached to resort to a rapid air reconnaissance. The initial selection of a route would be made on the basis of information supplied by such flights. Ground surveys would then be undertaken. Construction work on the road and the pipeline would follow, just as soon as contractors could establish their organizations in the field. Accordingly a number of flights were made over the area situated between Norman Wells and Whitehorse. The terrain was studied from altitudes ranging up to 12,000 feet. As a result of these air surveys the Mountain River valley appeared to be preferable to the Gravel River route. Efforts to carry out ground surveys in the case of the former proved futile, however, because heavy vehicles employed by the surveyors bogged down in the soft soil of the Mackenzie River valley.

A decision to abandon the tentative location line was soon made. But time was fast running out and a feasible route had to be projected so that construction could commence in the spring of 1943. Indians at Fort Norman spoke about an obscure trail that they regarded as an improvement on any of the routes already considered. This trail, the natives claimed, by means of an almost concealed break in the mountainous barrier, entered the range that flanks the Mackenzie River to the west. Blanchet thereupon resolved to make an overland reconnaissance, using a train of dog teams. Early in October, 1942, he set out from Teslin River with five dog teams. After travelling one hundred miles he sent back two of these units to the starting point. His examination of the country between Johnsons Crossing (at Teslin River where it leaves Teslin Lake) and Pelly River produced a satisfactory location for the Canol Highway over that part of its total length. In the same season and covering that same distance a survey party followed Blanchet in tractors and carried out a stadia traverse. Air photographs helped to establish line location as far as Christie Pass. This latter feature crosses the continental divide on the border between Yukon Territory and the Northwest Territories.[18]

Blanchet, with his three dog teams, travelled light and in company with several Indians familiar with the region and adept at living off the land. Only track survey methods were employed by Blanchet, including compass bearings, estimated distances and barometer elevations. The Indian trail proved to be a remarkably good one, established by natives who knew every mountain, valley, and pass. The trail followed the deep canyon of Sheep Nest's River, a tributary of the Carcajou. This route involved a climb to a point nearly 5,000 feet above sea level. One of Blanchet's Indian guides had to draw frequently on his faltering memory in selecting the proper path to follow. At one stage in their progress the party had to rely on a sketch drawn by an old native who was much more skilful in hunting game than in the arts of cartography. One of the guides accompanying Blanchet also drew maps of the country as the party advanced and although, taken separately, these were very rough representations, in combination they provided a fairly comprehensive depiction of the region's topography.

After what seemed to its members an interminable time the reconnaissance party finally broke out of the high ranges into the wide expanse of a plateau. Blanchet, in a poetic mood, recorded his impressions in his diary: "At last we are clear of the crowding mountains. The sun shone brightly on us today and our view expanded. From the summit of the pass we could see far to the southwest . . . at the limit of the view we could see a massive range where the Selwyns form the continental divide and, dim and shadowy as a cloud, rising above them was a peak which, I think, is Itsi Mountain."[19]

Following Blanchet's reconnaissance it was concluded that the route offered no major difficulties and, in fact, much of it was reasonably satisfactory for road and pipeline construction. In the late winter of 1942-43 a tractor train carried the survey as far as the continental divide. By springtime the reconnaissance on the ground had been completed from Norman Wells to the Alaska Highway. In the surveys that followed some formidable obstacles were encountered. Close distances were required for computing sites of pumping stations and these were sometimes difficult to obtain because construction factors led, in a number of instances, to local changes of route. At times resurveys were required when the pipeline left the line of surveyed highway.

By late September, 1943, Blanchet drove by car over a completed part of the Canol Highway. "It seemed incredible", he observed, "to be driving easily and swiftly over a highway where, just a year before, we had been considering a wilderness from the air, studying the possibilities of penetrating it . . ." Early in December roadbuilding work was largely finished and about mid-January, 1944, the final weld was made connecting the pipelines advancing from Whitehorse and Norman Wells respectively. The rugged mountain barrier had been successfully traversed in 20 months and a long, sinuous oil supply line now wound through the shaded valleys and high passes, close to a new highway that crossed a land remote and uninhabited save for mountain sheep on the steep slopes and by bears as well as moose in the lowlands.

At the cost of fantastic exertions and considerable human hardship as well as expenditures of more than $130,000,000, this basically uneconomic but potentially invaluable project ended in a dismal anti-climax. Five years after its completion, in 1949, the wartime emergency having disappeared, much of the Canol Highway was allowed to fall into disrepair, more than five hundred miles of 4-inch pipeline was dismantled, and the newly-built refinery at Whitehorse was transferred to Edmonton by Imperial Oil Limited.[20]

In subsequent years only parts of the Canol Highway were rehabilitated. But the exploratory surveying and mapping activities carried on by Canadians such as Joseph Keele, Knox F. McCusker and Guy Blanchet made possible the launching and completion of major wartime projects at a critical stage in the defence of North America in the 1940s. Their efforts to probe an unmapped and remote northern land in order to unlock its secrets and to overcome its problems, represent triumphs of the human spirit and of human endurance over heavy odds. Their achievements reflect immense credit upon the profession in which these doughty trail-blazers served with such resourcefulness and distinction.

The construction of the Alaska Highway, completion of the Canol Project, and the establishment of a system of airfields in northwestern Canada created a pressing need for Canadian surveys of various types. To meet this requirement both military and civilian authorities, in the mid-1940s, launched programs of control and miscellaneous surveys designed to extend over a period of years. Early in 1946 the Department of National Defence took over from the Americans the maintenance of the Canadian portion of the highway, access roads to airfields as well as landing strips along the Northwest Staging Route, in accordance with the terms embodied in the 1942 exchange of notes between Canada and the United States.[21] The Corps of Royal Canadian Engineers, in particular, was entrusted with the administration of this undertaking known as the Northwest Highway Maintenance Establishment. Realignment and relocation work had become necessary on the highway in some sections. Several temporary bridges had to be replaced by permanent structures. All these reconstruction activities called for the special services of the Army Survey Establishment, R.C.E. For example, in the five-year period, 1953 to 1957 inclusive, a total of 89 major survey tasks was carried out by army survey parties. The Royal Canadian Air Force continued its program of aerial photography designed to assist in mapping the region. Map sheets were completed on each side of the highway over its entire length.

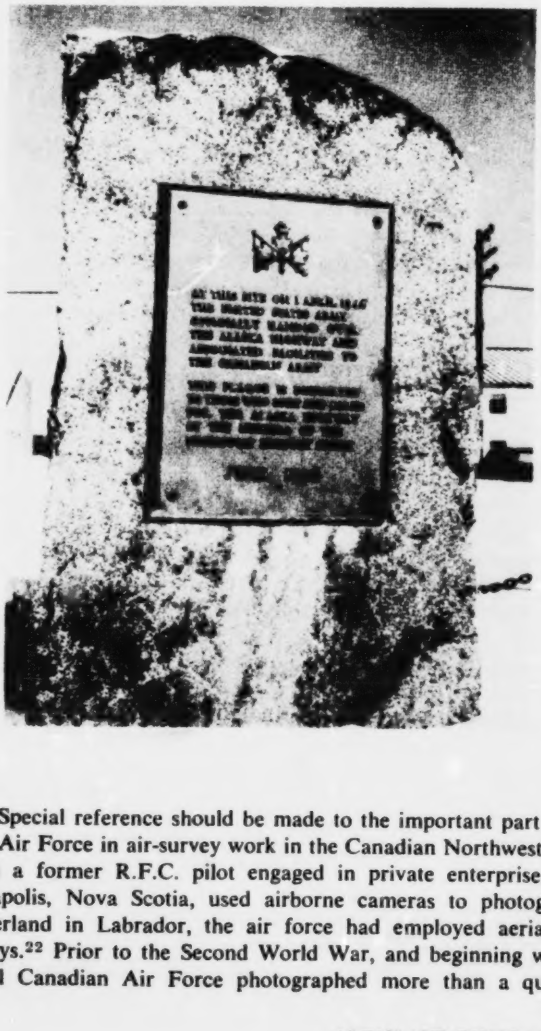


FIGURE 65
Plaque near Whitehorse, Yukon, commemorating transfer of the Alaska Highway from United States to Canada, 1946.

Special reference should be made to the important part played by the Royal Canadian Air Force in air-survey work in the Canadian Northwest. From the summer of 1919 when a former R.F.C. pilot engaged in private enterprise, Captain Daniel Owen of Annapolis, Nova Scotia, used airborne cameras to photograph 250 square miles of timberland in Labrador, the air force had employed aerial photography in northern surveys.[22] Prior to the Second World War, and beginning with hand-held cameras, the Royal Canadian Air Force photographed more than a quarter-million square miles.

Processing techniques gradually improved so that raw film could be successfully converted into forms suitable for map making.

As the end of the war approached the Royal Canadian Air Force resumed its intensive air-survey work. Cameras could now be installed in long-range, multi-engine aircraft capable of high-altitude flights. The trimetrogon camera came into use, permitting aircraft to take three photographs simultaneously, portraying the full sweep of the horizon ahead. From 1944 to 1955 the Royal Canadian Air Force photographed every square mile of northwestern Canada and supplied data to cartographers in the form of photographs of three and a half million square miles, the largest such program undertaken in the world up to that time.[23]

While its trimetrogon work was being carried on the Royal Canadian Air Force experimented with vertical photography in order to provide more detailed pictures for use in large-scale mapping activities. Civilians were encouraged to increase the scope of their ventures in air-survey work. In fact the Royal Canadian Air Force loaned aircraft and released trained men for such employment. As civilian operations increased in this field, Royal Canadian Air Force activity lessened.

On the ground and along the Alaska Highway Canadians were increasingly active. A technical officer, James Quong, serving with the army maintenance organization, was in charge of control for bridge design engineering. One of his most memorable experiences occurred during the winter of 1944-45 when he was surveying on the Alaska Highway one very frosty morning, assisted by a rod man. The temperature reached thirty below zero during the performance of their duties. About mid-morning Quong looked through his instrument but failed to see either rod or man. The assistant did not reappear. Either he had been dragged off by a wild animal or, more likely, had departed from the scene without due formality and headed for points south. In all probability his sudden leave-taking was inspired by the conviction that no sane person would attempt to carry out a survey under such adverse conditions![24]

Geodetic, topographic, legal and geological surveyors in the employ of the federal government, began to appear on the Alaska Highway and in adjoining areas in increasing numbers. Field parties of the Geodetic Survey of Canada were busy during the seasons 1944 to 1953 inclusive. In the 1943 season a party of the United States Coast and Geodetic Survey had completed an extension of its Alaskan triangulation net from White Pass station, north of Skagway, along the line of railway to Whitehorse and then along the Alaska Highway to Fairbanks. J. V. Thompson of the Geodetic Survey of Canada served with the American party, accompanying it as far as the Yukon-Alaska border. In 1945 the primary net in the region was projected as an extension from Whitehorse to the vicinity of Watson Lake. The Canadian program involved the continuation of this triangulation net along the entire length of the Alaska Highway eastward to Dawson Creek and beyond until a junction could be made with the Alberta primary net in the vicinity of Edmonton. These activities were intended to provide immediate control for surveys and mapping along the British Columbia-Yukon boundary as well as control for surveys of the highway itself and areas adjoining it.[25] During the five-year period some of the geodetic surveyors active in this work were George Hueston, G. M. Gibling and F. P. Steers.

In the spring of 1948 experiments were made in the use of the helicopter in order to test its capabilities for transporting reconnaissance, observing and light-keeping personnel and equipment from base camps to triangulation stations in mountainous terrains. Washouts and floods along the highway resulted in delays, including the delivery on site of helicopter gasoline. It was not until the morning of June 20th that the first test flight was made. This event marked the initial trial of a helicopter on Canadian geodetic work.[26] Rain and fog hampered observing work during much of the 1948 season. But these surveyors encountered troubles other than those related to inclement weather. One of the light-keepers reported ill and asked to be taken to the outside. Fortunately his case was quickly and correctly diagnosed as the effects of an allergy to pollen of balsam trees. Removal of the man from the vicinity of any heavy concentration of balsam speedily corrected his bronchial and asthmatic condition. Two days after this cure one of the two packers employed by the survey party began to suffer with a badly infected tooth. It was necessary to transport him to Whitehorse for the extraction. In his absence three pack horses wandered off and were lost for three weeks. While the search was under way for these missing steeds, two others were found and used by the party until autumn when the animals were turned over to their owner at Lower Post.

FIGURE 66
Levelling operations along the Alaska Highway, Geodetic Survey of Canada.

In addition to triangulation work for the Canadian government, the Geodetic Survey undertook in 1944 to extend the precise level net from Edmonton to join at Whitehorse the corresponding net established in the previous year by the United States Coast and Geodetic Survey. David MacMillan (1888-   ), in later years chairman of the Ottawa Transportation Commission, was in charge of this work in the season of 1944. Two double-unit levelling parties were involved in this plan to add an important link to the international level system of North America and to provide as well basic vertical control which, up to that time, had been lacking in northwestern Canada.

The need for various kinds of legal surveys quickly grew with the turnover of the Alaska Highway to Canadian administration. McCusker, assisted by the Dominion land surveyor John Bevan Walcot, monumented along the highway, beginning in the survey season of 1944 and continuing until the early 1950s, and produced plans of the right-of-way.[27] In the field season of 1946 Lorne Louis Anderson and Theodore Hans Kihl, both of whom became Dominion land surveyors a few years later, assisted McCusker as articled students. In the 1947 season Edgar John Benson, destined to become Minister of National Revenue (then Finance) for Canada in the 1960s, served as chainman on the final 100 miles of survey on the highway up to the border between the Yukon and Alaska.

In addition to right-of-way surveys there were legal surveys conducted to define intersections of the highway with lines of private property, for highway relocation and, on occasion, the establishment of airport boundaries.

Men of the Topographical Survey of Canada were also exceedingly active in post-war seasons in the regions served by the Alaska Highway. As an example, in the 1948 field season 12 parties from this organization surveyed 26,700 square miles by photo-topographical methods for maps published on a scale of 4 miles to the inch, also 1,052 square miles for maps to be published on a one-mile-to-the-inch scale. These surveys, beginning in 1947, were reinforced by five parties from the Canadian Army Survey Establishment. The Dominion land surveyor, William N. Papove, B.C.L.S., A.L.S., was engaged during this same period by the government of British Columbia in boundary (British Columbia-Yukon) survey work, frequently conducted in the vicinity of the Alaska Highway.

7

CANADIAN HYDROGRAPHIC SURVEYS: 1917-1947

"... *no gold for sounding:*"
—*Romeo and Juliet*, Act 4, Sc. 5.

Charts may be described as road maps of navigable waters for the use of mariners, designed to reveal the bend of the coastline or shorelines, the position of rocks, shoals or other submarine hazards, and of lights and buoys. Charts also show depths by figures representing fathoms or feet, as well as depth contours. All this vitally important information is derived from hydrographic surveying, a service inseparable from, and indispensable to, safe navigation. Because sand tends to shift, especially in estuaries, and because larger ships with deeper draughts continue to be built, many areas in Canadian waters require resurveying from time to time. Increases in volume of ship traffic in a waterway or sealane also may call for renewal of surveys.

As has been shown in previous volumes of *Men and Meridians* hydrographic surveying has been closely linked with the story of the discovery, exploration, colonization and economic growth of Canada. The spectacular expansion of British sea-power in the 19th century, both in naval and mercantile functions, was accompanied by considerable hydrographic survey work. Seacoasts in all parts of the travelled world, including those of Canada, were surveyed and charted by ships of the Royal Navy. A result of all this scientific and exploratory activity was the accumulation by the British Admiralty of a stock of charts, compiled and published by its Hydrographic Department, covering the navigable waters of the world.

Admiralty charting came to an end in British Columbia waters following the 1910 survey season (*Men and Meridians*, Vol. 2). It was under Captains Cook and Vancouver that charting by the British Admiralty had commenced along that part of the Pacific Coast of North America a century and a quarter earlier. Canadians, two decades before

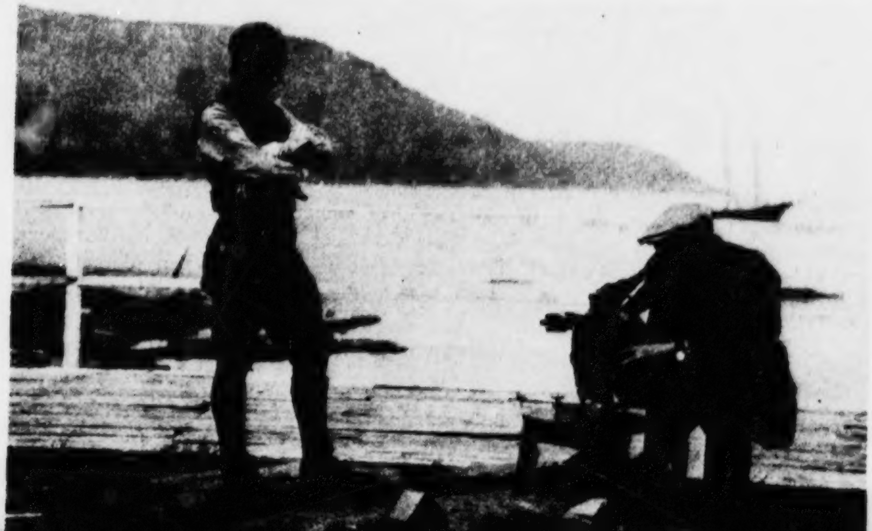
1910, had taken over from the "Men of Admiralty" the task of surveying waters of the Great Lakes. On the Atlantic Coast Admiralty surveys in Canadian waters largely concluded about 1902 and in Newfoundland waters in 1939. During the Second World War numerous surveys were conducted for defensive purposes by the Canadian Hydrographic Service along the Newfoundland seaboard, although it was not until 1949 that Newfoundland became Canada's tenth province.

Since the cessation of their surveys in the waters of Canada the British Admiralty has been content to accept Canadian data in the updating of their charts applicable to this part of the world. About the middle of the 20th century the Admiralty turned over to Canadian authorities the responsibility for the production, distribution, and maintenance of all their charts of harbors, coastal waterways, and inshore waters of Canada, where Canadian information was not available to them. In pursuance of this decision reproduction material was provided by the Admiralty for more than 100 charts. These were published as Canadian charts, with due acknowledgment in the legends to information sources.

When the First World War began in the summer of 1914 the Hydrographic Survey of Canada, as it was still known at that time, had six vessels in commission, five steamers and an auxiliary schooner. Of this fleet the *Acadia* and *Cartier* were on the Atlantic seaboard; *Bayfield* and *La Canadienne* on inland waters (Great Lakes); *Lillooet* and schooner *Naden* on the Pacific Coast. In 1917 the *Acadia, Cartier* and *Bayfield* were taken over by the Canadian Navy for the duration of hostilities. Due mainly to years of severe economic depression in the 1930s, followed by the period of the Second World War and its immediate aftermath, it was not until the 1950s that Canada's hydrographic fleet began to return to its 1914 proportions. During the period 1939 to 1945 certain hydrographic survey projects in aid of the allied war effort were carried out by the Canadian organization. On the whole, however, only routine surveys, performed by small field parties, were undertaken in Canadian waters during the years of widespread conflict.

But the advent of the First World War did not prevent the carrying out of Canada's first oceanographic cruise in 1915. Under the direction of Dr. Johan Hjort the *Acadia*, with Captain F. Anderson in command, conducted offshore soundings between Halifax and Newfoundland as part of an oceanographic study bearing on the long-term outlook for Canada's east-coast fisheries.

FIGURE 67. Captain Frederick Anderson (seated) using sextant and artificial horizon at Rigolet, Hamilton Inlet, 1921. G.-A. Bachand, at left, was drowned 10 years later in Netagamu River.



During the 30-year period reviewed in this chapter, Canada's hydrographic survey organization was shifted in 1922 from the Department of Naval Service with which it had functioned since 1910, to the Department of Marine and Fisheries; then, in 1930 to the Department of Marine and to the Department of Transport in 1936. Until its transfer to the Department of Mines and Resources in 1936 the organization, for a brief period, was in the Department of the Interior, a title that disappeared in that year. Throughout these administrative changes its duties remained basically the same, namely, to investigate the navigable waters of Canada; to take soundings of and to chart courses through its rivers and along its coasts; and to survey and chart its various harbors and their entrances.

In the season of 1917, despite service curtailments imposed by wartime priorities as well as by heavy rains that washed out a total of 62 working days, surveys were carried out along the Pacific Coast of Canada by the *Lillooet's* crew under Captain P. C. Musgrave. Soundings were taken in Hecate Strait as well as between Ocean Falls and Prince Rupert. By means of launches and other small craft similar work continued along the Atlantic Coast. Since 1912 automatic gauges had been installed and maintained on the Great Lakes and in the St. Lawrence River. Also in that year certain stream measurements had been commenced in the Great Lakes, activities that were transferred to the St. Lawrence River below Montreal in the following season. These efforts were temporarily discontinued in 1917.

With the release of hydrographic vessels from naval duties, survey work resumed in the 1919 season. When Musgrave died in the next year, Henry Dalpe Parizeau (1877-1954) took charge of Pacific Coast operations and produced new charts of Victoria and Esquimalt harbors. In 1920 Commander J. H. Knight resurveyed Quatsino Sound near the northwest tip of Vancouver Island. This survey project was made necessary by the establishment of a large pulp plant and sawmill at Port Alice.

In 1921, at the request of the federal Department of Public Works, a preliminary survey was made of Ripple Rock in Seymour Narrows, 110 miles northwest of Vancouver. This submerged reef had been a deadly hazard to navigation through the Narrows. Its tragic toll over the years included at least 114 lives lost and 20 major ships sunk. The 1921 survey was an essential prelude to the eventual destruction of the twin-pinnacled menace. After years of study and careful preparation Ripple Rock was demolished in April, 1958, after underwater shafts had been drilled and explosive charges laid at the base of the pinnacles. The resulting blast, the largest non-atomic explosion engineered up to that time, was powerful enough to have lifted New York's Empire State Building one mile in the air. The hydrographic vessel *Parry* investigated effects of the demolition upon channel depths and the tidal-current conditions in this part of the Inside Passage.[1]

In the early 1920s Canadian hydrographers, in the east and west alike, rebelled against the inadequacy of funds voted by Parliament to cover the cost of their survey programs. In the face of increasing complaints from owners whose vessels had been all too frequently scraping bottom in the St. Lawrence ship channel, the annual report for the Survey in 1923 contained the following admonition:

"Unless the larger development of the river is proceeded with in the near future it is . . . highly desirable that a new survey of this part of the river (Cornwall to Kingston) be made without loss of time. The only charts of that portion are from American sources. They were made by the Lake Survey many years ago when the appliances for proper hydrographic work were not as fully developed as today. The

FIGURE 68.
Prince's Shoal lighthouse, St. Lawrence River off mouth of Saguenay River. Note landing deck for helicopters.

channels are all on the Canadian side of the boundary line and nine-tenths of the traffic is Canadian or in Canadian waters."

This tart observation was matched by an accompanying complaint from the Pacific Coast office: "The work of the Hydrographic Survey in British Columbia is particularly important; most of the old charts are very much out of date and new rocks are from time to time reported. Calls are frequently made on the Survey for examinations and much time is lost in running about to get this information. It is hard to see how such a condition can be avoided unless more funds are put at our disposal and the staff increased, with additional steamers."[2]

Despite the continuing lack of funds, experiments were carried out between 1919 and 1923 on the *Acadia* off the south shore of Nova Scotia in radio compass work. Efforts to improve offshore positional accuracy for survey purposes by means of the new direction-finding equipment were not entirely successful. Shore stations, under this system, provided bearings to wireless-equipped vessels with sufficient accuracy for navigation but the results were not precise enough for survey purposes.

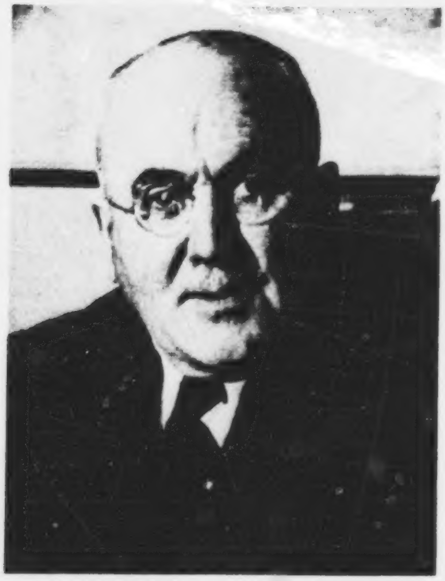


FIGURE 69. R. J. Fraser.

The extent of Service dissatisfaction with a decade of impoverishment imposed upon it by federal fiscal policies found renewed expression in the strongly-worded declaration, probably composed by R. J. Fraser, that appeared in the 1924 annual report of the organization:

"Over 100 years ago the British Admiralty took up the hydrography of the waters of Canada, starting in the Great Lakes in 1820 [1815: ed.] and about 25 years later the Atlantic Coast, and 10 years after that, the Pacific Coast. However, owing to the primitive methods at their disposal and the large areas covered, their surveys were little more than the delineation of the coastline, taking a few soundings, with the exception of important harbours where an attempt was made to compile a finished chart . . . Wood has given place to steel, sail to steam . . . every attempt is being made to save time, taking the shortest routes . . . and causing the demand for accurate charts. In days of sailing craft, a vessel lost meant the loss of a few thousand dollars; today it may mean millions. In 1904 Hydrographer to the Admiralty [Wharton] stated: 'The surveys of the shores of the Dominion, made as a rule by Imperial officers some years ago, are very inadequate to the needs of modern navigation.' Since then 20 years have passed and the size and number of ocean-going vessels have increased immensely, demanding the most accurate information regarding bottom contours when approaching the shore, especially in frequent fogs off the Atlantic Coast . . .

"Since the Hydrographic Survey Branch was formed in 1905 when Canada, at the urgent request of Great Britain, consented to undertake the recharting of her own waters, considerable progress was made in the Atlantic and to a less extent on the Pacific Coast, however, not one-half sufficient to meet the demands for new surveys and, considering the entire coastline of Canada, it will take a long time to complete the whole."

In the concluding part of this statement it was emphasized that from Belle Isle to the Bay of Fundy, 100,000 square miles of coastal charting remained to be done and that the Magdalen Islands survey had been only half-completed. It was also pointed out that existing charts of the Gulf of St. Lawrence were "more of a menace than a benefit" and apt to mislead navigators. As to the performance of a complete survey of the Labrador Coast, of Hudson Bay and Hudson Strait, no estimate could be made. On the Pacific Coast, it was pointed out, 5,500 miles of coastline remained to be surveyed, although 2,700 miles had been charted.

A quarter-century after this resounding statement was published, and soon after Fraser was named first Dominion Hydrographer, the British Admiralty announced that in regard to the coast of British Columbia, it would in future rely on Canadian charts and would be withdrawing from circulation upwards of 40 charts of its own construction. The announcement indicated that the policy of the Admiralty in future would be to confine its own chart coverage of Canadian seaboards to general coastal sheets and intermediate-scale charts.

In 1924 Dr. W. Bell Dawson retired as head of the Tidal and Current Survey. Under terms of the relevant Order in Council the position was not filled. Functions of that unit were assigned to the Hydrographic Survey and administered as part of that organization. Although the Chief Hydrographer was nominally responsible for its activities, Harold William Jones (1880-1950) as Senior Tidal and Current Surveyor, Atlantic Coast, stationed at Ottawa, carried the main administrative load. Sydney C. Hayden (1876-   ) with a similar title, Pacific Coast, was stationed in British Columbia. He had been assigned to that region in the year that Dr. Dawson retired. In May, 1940, Jones was made Chief, Tidal and Current Survey Division of the Canadian Hydrographic Service.

For some years, while the Tidal and Current Survey had developed through its early stages under Dawson, the federal government failed to provide funds for the publication of Canadian tables of tidal predictions. Dawson, accordingly, was forced to arrange as best he could, and from port to port, for the printing and circulation of this hard-won information. Early in the 20th century, however, the Survey began to print and distribute its own tide tables. By 1923 their annual circulation, including Atlantic and Pacific regions, attained a total of 66,500.

FIGURE 70. Dr. W. Bell Dawson.

FIGURE 71. H. W. Jones.

Along the coast of British Columbia, where the inflow and outflow of tidal waters create dangerous turbulence, the relationship between tides and currents is obvious. Dawson's investigations in British Columbia were directed mainly to the prediction of the time of slack water in the various passages. Usually these investigations could be carried out from shore positions. By 1917 methods of calculating slack water conditions in Seymour Narrows and related channels had vastly improved. All of this information was essential to coal transportation and lumbering industries in that part of Canada. To these interests it was particularly valuable to know the exact periods during which passages and river entrances were navigable, as well as to have data on the direction and force of currents. In the same way tide tables and associated publications relating to Hudson Bay and James Bay proved highly useful to commercial interests using those waters, especially to the Hudson Bay Railway in the operation of its terminal facilities.

Years of steady improvement in Canadian tidal and current surveys culminated in a vast leap forward with the appearance of the computer. By this mechanism only about one hour would be required in the making of calculations for, and printing of, tide tables for one port for a year. About 100 computer hours would result in the production of tide tables for all Canada covering any single year.[3]

The investigation of currents in and near the Gulf of St. Lawrence was attended by formidable difficulties. The currents, which could be observed properly only from a ship, proved immensely complex and varied. Dawson found that the waters of the Gulf circulated generally in a counter-clockwise direction and that the current shifted speed and direction throughout the course of a day. The tide pours into the Gulf through Belle Isle and Cabot Strait. It builds up rapidly as it travels through the narrowing St. Lawrence estuary, taking about ten hours to cover the distance from Seven Islands to Lake St. Peter. On the river above this point tidal action does not exert any important influence. The rise in height is greatest at Quebec City, reaching 13 or 14 feet. On the Pacific it takes the tide about six hours to travel up Juan de Fuca Strait into the Strait of Georgia, increasing in height until it reaches 12 feet at the north end of the latter strait. Knowledge of tidal phenomena in our Arctic waters is still relatively sketchy but is growing year by year. Generally the action of the tides is slighter in Arctic regions than elsewhere on Canada's coasts. But the first tide tables for the Arctic Ocean of this country, calculated and published in Canada, were not to appear until the mid-1960s.

On all three ocean coasts the intensive accumulation of tide and current data has taken on a new significance owing to the insatiable appetite of the digital computer allied with the skill and dedication of hydrographic personnel in translating raw facts of their investigations into computer terms.

In the year following Bell Dawson's retirement, Chief Hydrographer William James Stewart (1863-1925) died and was replaced in that post by Captain Frederick Anderson (1869-1957). For more than four decades Stewart had served the hydrographic organization with special distinction and for about half of that period had given outstanding leadership in the direction of its affairs.

In 1926 funds for the Survey were too limited to maintain the *Bayfield* and *Cartier* in active service and the latter vessel was loaned to the Preventive Service, Department of National Revenue, until the end of the season. Two years later, in 1928, the title "Hydrographic Survey of Canada" was changed to "Canadian Hydrographic Service" and the title "Automatic Gauges Unit" was altered to "Precise Water Levels Division". In that same year the structure of civil service positions in the organization was also transformed and made retroactive to April 1, 1927. The system of senior and junior hydrographer was thereby supplanted by the establishment of graded positions of that general title. That same season, 1928, marked the beginning of hydrographic survey work in Great Slave Lake (under H. L. Leadman), and renewed work in Churchill Harbour (under F. C. G. Smith) initiated by Bachand and Savary in 1910. That season

FIGURE 72. F. C. G. Smith.

also marked the commencement of electronic surveying in the Service with the installation of the first gyro compass on the *Acadia*. In the following year, 1929, the *Acadia*, newly fitted with the first echo sounder to be installed in a Canadian hydrographic vessel, entered northern waters for the first time since 1914.

By 1933 an echo sounder, known as the Acadia-Challenger model and named after the Canadian ship and H.M.S. *Challenger* (the British Admiralty survey vessel) had been installed on the *Acadia* as well as the *Cartier* and the new ship on the Pacific, the *Wm. J. Stewart*. A version of this sounder was also placed aboard the government ice-breaker *N. B. McLean* for special use in Hudson Strait. In that same season the first of the fleet of government launches to be equipped with a supersonic model of echo sounder was the *Boulton*, built in 1926.

The pioneer echo-sounding apparatus included a 70-pound air hammer, electromagnetically controlled, employed to deliver resounding blows on an anvil assembly to which was attached a steel diaphragm, inside the hull of the investigating ship. In this manner vibrations were set up to which the sea bottom would respond. This early equipment included head phones in which a certain pitch of tone would indicate to the operator that the signal from the hammer was being returned. By the beginning of the Second World War about a dozen Mark 2 and Mark 3 echo sounders had been installed on Canadian hydrographic vessels. These classes of sounders dispensed with the air hammer and head phones. The pulse was produced by the magneto-striction principle and a recording apparatus was added in order to obtain a profile of the bottom.

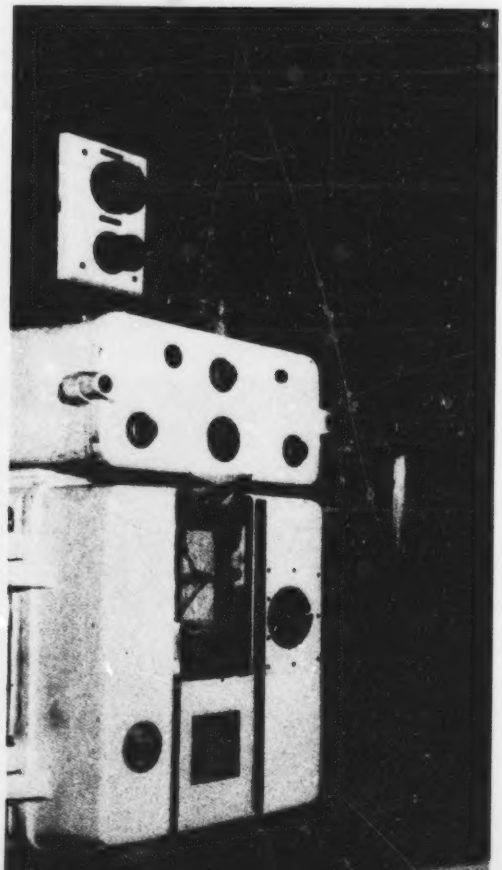


FIGURE 73
Echo sounder, about 1937.

During the seasons of the early 1930s men of the Canadian Hydrographic Service discovered and charted several dangerous formations, consisting of submerged rocks along the main trans-Atlantic steamship lane through the Strait of Belle Isle to ports along the St. Lawrence River. Two of these hazards, Bent Rock, and nearby Roach Rock, were situated off the north shore of the Gulf, not far from Cape Whittle. The first was named for R. W. Bent, who had been an assistant to Bachand; the second for Captain James Roach, a skipper of the *Cartier*. In the season 1930 the *Bayfield*, in Leadman's charge, located and charted Superior Shoal, a previously undetected hazard to shipping, situated near the direct route between the head of the lakes and Sault Ste. Marie. This submerged rock formation is now believed to have been the cause of mysterious disappearances of a number of lake vessels over the years.

In the 1931 season the *Bayfield* ended her survey days in the Gulf of St. Lawrence, and in the following year this vessel was taken out of the Hydrographic Service. In 1933 the Esquimalt-built, twin-screw *Lillooet*, which had been active as a hydrographic survey vessel on the Pacific Coast since 1908, was replaced by the *Wm. J. Stewart*, constructed in Collingwood, Ontario, and brought to the west coast through the Panama Canal. Two years later the launch *Henry Hudson* was added to the national fleet and, for the first few years of its career, surveyed in Hudson Strait.

Air photographs were first used in 1930 as a survey aid by the Hydrographic Service. During initial stages of the season's operations the Royal Canadian Air Force performed the photographic work, flying along the north shore of the Gulf of St. Lawrence opposite Anticosti Island. A newcomer to the Hydrographic Survey at the time, New Brunswick-born S. R. Titus, studied the resulting photographs in Ottawa during the succeeding winter months with a view to applying the information to hydrographic purposes. Air photography has since continued to be an indispensable aid to the charting of Canadian waters and, over the years, various refinements in this special service have been developed, including the provision of photographs of specified areas, taken both at low and high tide.

First fatalities in the history of the Service occurred during the 1931 season when G. A. Bachand (1874-1931), chief of the *Cartier*, and two seamen were drowned on June 8th in the Netagamu River near the north shore of the Gulf when their heavily-loaded canoe capsized in turbulent waters. In this tragic manner Bachand's long and distinguished career, beginning in 1905 and during which he had served his country well as a hydrographer, came to an end. The extent of his contribution may be judged from the repetition of Bachand's name on some 40 Canadian navigation charts.

Surveyor General F. H. Peters, Ottawa, succeeded Captain Anderson as head of the Hydrographic Service in 1936. Soon after his appointment to the dual functions of

FIGURE 74 F. H. Peters.

Surveyor General and Chief, Hydrographic and Map Service, Peters visited the Pacific Coast on an inspection tour and, as a result, from 1938 onwards there has been a permanent regional office of the organization at Victoria, operating on a year-round basis.

When the Second World War commenced the *Cartier* was active off the coasts of Cape Breton Island under Leadman's charge. His senior assistant at the time was Yarmouth-born Norman Gerald Gray (1906-   ), destined to become Dominion Hydrographer. Louisbourg was then the *Cartier's* port of call for supplies, the place where, in 1758, the era of Paris-directed surveys in the New World gave way to a new age of British surveys and surveyors leading up to Confederation.

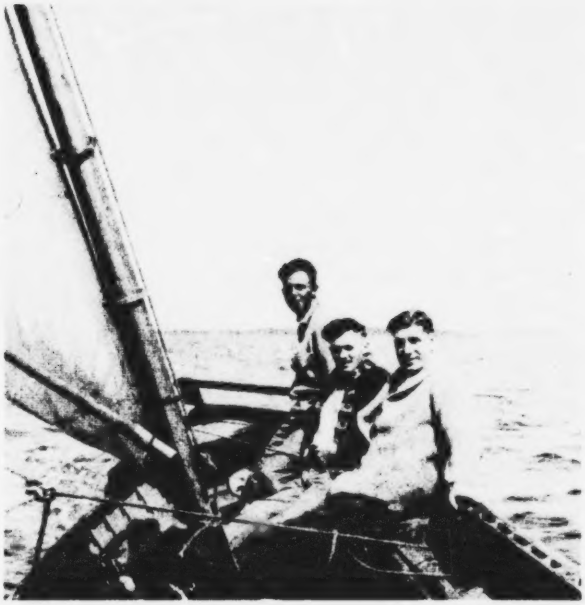


FIGURE 75
N. G. Gray (at tiller) with fellow hydrographers sounding near Magdalen Islands about 1931 in one of the last hydrographic sailing gigs to be employed off Canada's coasts.

Immediately after the declaration of war (in which Canada became a foe of Hitler's Germany) the *Cartier* proceeded to Shediac, New Brunswick, where survey launches, dories, and equipment were left for the prosecution of survey work in Shediac harbor and its approaches. By way of Charlottetown, where its remaining survey gear was placed in storage, Leadman took the *Cartier* to Halifax. There the vessel was turned over to the Canadian Navy. Charlottetown, incidentally, was the home port of the *Cartier*.

In 1940 informal discussions took place between representatives of the United Kingdom, the United States, and Canada bearing upon the need for ferrying bombing planes from North America to the British Isles over a North Atlantic route. These discussions led, in turn, to the decision to establish an air base in Labrador. At the time, both Canadian and United States air forces were conducting operations in Labrador, searching for a suitable airport site. On receipt of survey reports from the Dominion

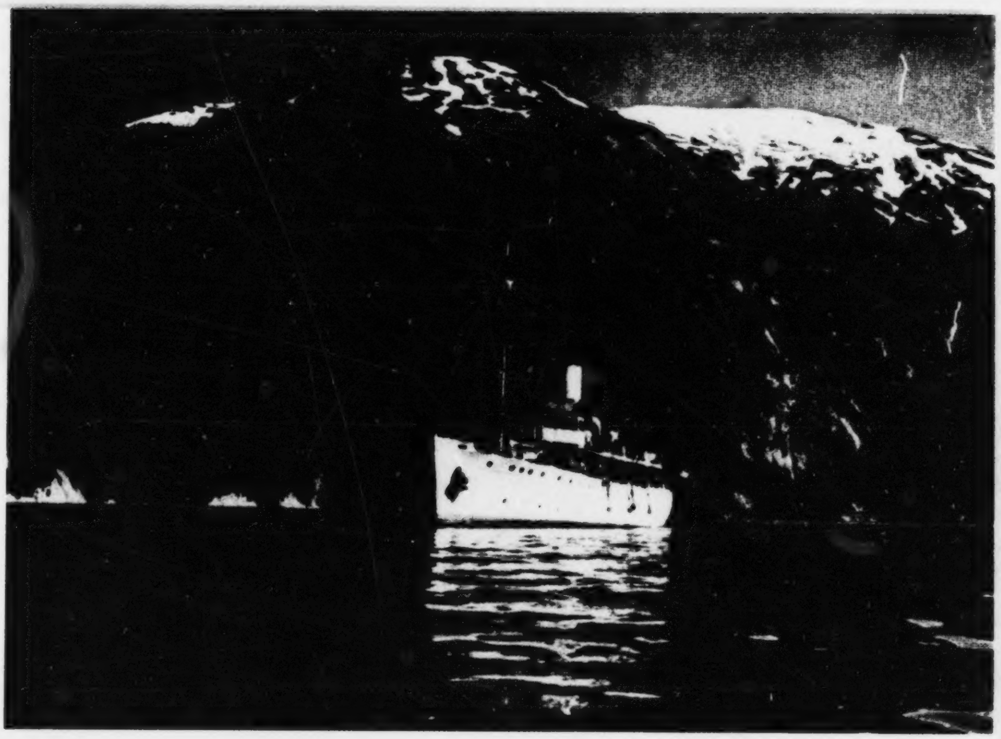


FIGURE 76. CHS *Wm. J. Stewart.*

land surveyor, Eric Stanley Fry (1890-   ) of Canada's Topographical Survey, that a relatively level area had been found at the head of Hamilton Inlet, accessible from the sea, the suitability of the location was confirmed. By late September, 1940, construction work on the site began. On April 15, 1942, a Liberator plane winged its way to Goose Bay airport en route to the British Isles, inaugurating east-bound flights on what was to become a busy trans-Atlantic wartime air ferry service.

An approach by sea to the vicinity of Goose Bay airport was essential to the movement of equipment and supplies to the construction site. In this regard men of Canada's hydrographic organization performed valuable services. A location for the main wharf was selected at the head of Terrington Basin, the westernmost extension of Hamilton Inlet, leading off Goose Bay which, in turn, is an arm of saltwater Lake Melville. Arriving on the *N. B. McLean,* Ralph Hanson, working alone, accomplished triangulation work in the area during most of 1942 season. A. L. Mack arrived to assist him late in the same year. Toward the end of October, 1943, soundings were taken throughout the inner basin. These surveys were carried through the narrows to Goose Bay and confirmed the existence of a natural channel of sufficient width for all shipping needs and of a depth of about four fathoms. The existence of a shallow bar across the eastern end of Goose Bay restricted passage to vessels drawing up to 21 feet. The maximum tidal range in these waters was found to be two feet.[4]

For many months German submarine thrusts, directed against the Atlantic lifelines that linked Great Britain with the food sources and war supplies of North America, gravely threatened the ability of the British people to resist a resourceful and powerful enemy. Allied ship losses continued to mount dangerously to a monthly peak in 1942 of 671,000 tons.

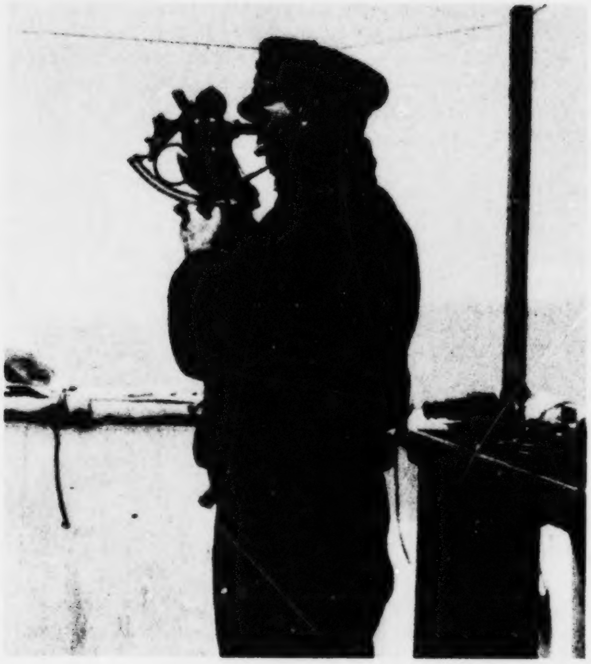


FIGURE 77
Captain D. M. Snelgrove (using sextant), only ship's officer to serve on all three major CHS vessels: *Acadia*, *Cartier*, and *Bayfield*.

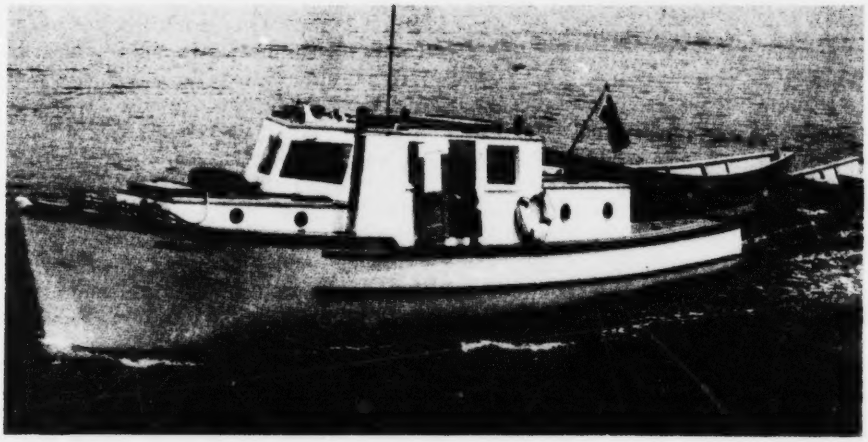


FIGURE 78. CHS launch *Anderson*.

FIGURE 79. H. D. Parizeau (with beard) and group of Pacific Coast hydrographers on the Wm. J. Stewart, about 1933.

Halifax never ceased to be in the front line of the naval war. In the vicinity of that port protective measures were developed not only to meet the submarine menace but also to reduce losses by the ingenious magnetic mine. A de-gaussing technique, devised by British scientists, was used to neutralize the innate magnetism of a ship by fitting electrically energized cables around its hull. The first 'open range' to be established in this connection outside the British Isles was located in Bedford Basin. Subsequently similar ranges were set up at Sydney, Nova Scotia, in Quebec City, and on the west coast. Hundreds of vessels were passed over these ranges for calibration of their magnetic properties and for the purpose of equipping them with de-gaussing cables.[5] Members of the Canadian Hydrographic Service were active in the delineation of these ranges and in furthering wartime harbor protection projects such as those at Halifax and St. John's where surveys were carried out from launches operating in advance of vessels laying antisubmarine nets.

Merchant ships for the British Isles from Canada, during the Battle of the Atlantic, were organized into convoys and escorted across the ocean by whatever naval or semi-naval units could be spared for the purpose. In Halifax, early in November, 1940, the armed merchant cruiser *Jervis Bay*, commanded by Captain Fogarty Fegan, R.N., required a gyro compass. Accordingly the *Cartier's* compass was removed and fitted aboard the escort ship just before she sailed with a 37-ship convoy. In mid-Atlantic the long line of vessels was approached by a powerful enemy raider, the new pocket battleship *Scheer*. Under orders the merchant ships scattered while the *Jervis Bay* engaged the *Scheer* in a most unequal contest, replying as best she could to the attacker's deadly broadsides with her old six-inch guns.

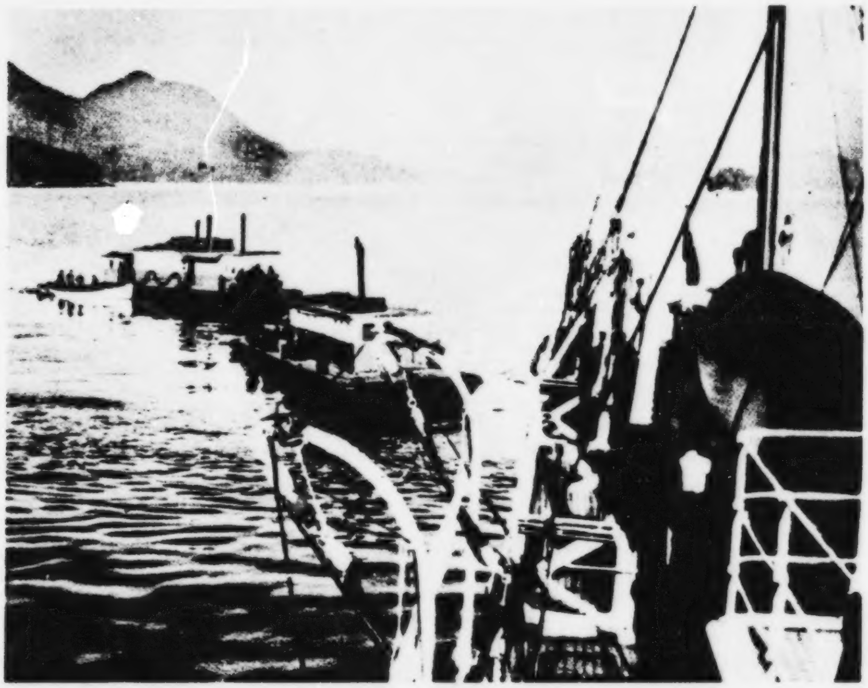


FIGURE 80. *Somass* (houseboat) and *Fraser* (water tender) being towed by CHS *Lillooet*.

Within the space of an hour the *Jervis Bay* was reduced to a shambles and soon sank, carrying to their doom its brave skipper (posthumously awarded the Victoria Cross) and more than 200 officers and men. But because the enemy's attention had been diverted from its helpless prey for a critical period, most units of the convoy escaped in the fast-gathering wintry dusk. Only five of the merchant ships were lost in the short time remaining to the *Scheer* before darkness set in. The gallant, sacrificial conduct of the *Jervis Bay's* captain and crew remains forever a shining page in the annals of sea warfare and in the most illustrious records of the British Navy. Later in the war the *Scheer* was sunk by allied air action while she sheltered in Kiel harbor.[6]

After the entry of the United States into the war President Franklin D. Roosevelt, through an emissary, conveyed to Prime Minister Churchill his desire to meet the latter in some "lonely bay" to be selected for the purpose of quietly discussing and formulating a joint Anglo-American declaration of principles.[7] The Placentia Bay area, south of the narrow isthmus linking Avalon Peninsula with the main part of Newfoundland, was favored by naval authorities as a meeting place for the two famous leaders. Although the special object of their request was kept hidden at the time from Canada's hydrographic service, that organization was asked by the British Admiralty to perform a survey of Mortier Bay, a relatively narrow body of water leading off the west side of Placentia Bay. Accordingly Heamen Lawrence Leadman (1887-1963) and a small staff sailed on the *N. B. McLean* from Saint John, New Brunswick, in June, 1941, and carried out a standard hydrographic survey of Mortier Bay, completing the task on August 1st. On the basis of this and other information made available to London the place of meeting chosen was Argentia harbor on the east side of Placentia Bay. In August Churchill arrived at the scene aboard the battleship *Prince of Wales*. Appropriately Roosevelt came on the United States cruiser *Augusta*. Broad agreement on joint war aims was reached along lines embodied in what came to be known to the world as the Atlantic Charter. None could have foreseen at the time that within a few months the *Prince of Wales* would be sent to a watery grave in Far Eastern waters by Japanese torpedo planes.

Canadian hydrographic surveys at Coral Harbour, Southampton Island, were instrumental in the establishment in that area of an airfield forming part of a system over which warplanes were ferried from Churchill to Frobisher Bay, thence across Greenland and Iceland to the British Isles. Another important wartime hydrographic survey on the east coast developed out of the decision to establish the large naval training base, H.M.C.S. Cornwallis, in Nova Scotia. In the 1942 season, N. G. Gray, using the launch *Anderson* and with the aid of two survey officers, began a survey of Annapolis Basin on the east shore of which the base was being constructed. This work was finished late in the following season, after completing a survey assignment for the Department of National Defence at Saint John. In 1944 hydrographic surveys were made, also under Gray's direction, in Northumberland Strait involving preliminary studies of a possible causeway crossing between the mainland and Prince Edward Island. Surveys in the Strait, using the *Anderson*, were continued in the 1945 season.

The volume of Canadian chart production and chart distribution rose steeply during the war period. In 1943, for example, 244 charts were printed and 83,936 copies distributed. This latter total represented an increase over the corresponding 1942 total of 65 per cent. In 1944 the total number of Canadian charts distributed reached a high figure of 106,042. Following the end of the war these totals declined sharply but this tendency was partly offset by an increasing demand for charts for civilian uses. Canada emerged from the Second World War showing a considerable advance in the total area of coastal waters charted as well as possessing sets of navigation charts superior to pre-war issues. Despite the increase in surveying of strategic waters for defence purposes, charting of other extensive ocean, lake and river areas had, perforce, to be postponed and a heavy backlog of civilian chart requirements accumulated. To that extent a marked imbalance in the general charting situation in Canada developed during the years immediately following the end of hostilities.

On the Pacific Coast, Parizeau was denied opportunities to expand the hydrographic service fleet and personnel, because of economies imposed by years of economic depression and world conflict. Despite these limiting factors Parizeau directed the transition on the Pacific Coast from traditional hydrographic survey methods to more modern techniques, including the use of echo-sounding equipment. He directed a gradual change in functions of the federal service over the years. In its early activities the Hydrographic Service on the Pacific concentrated largely on assisting the natural resource industries

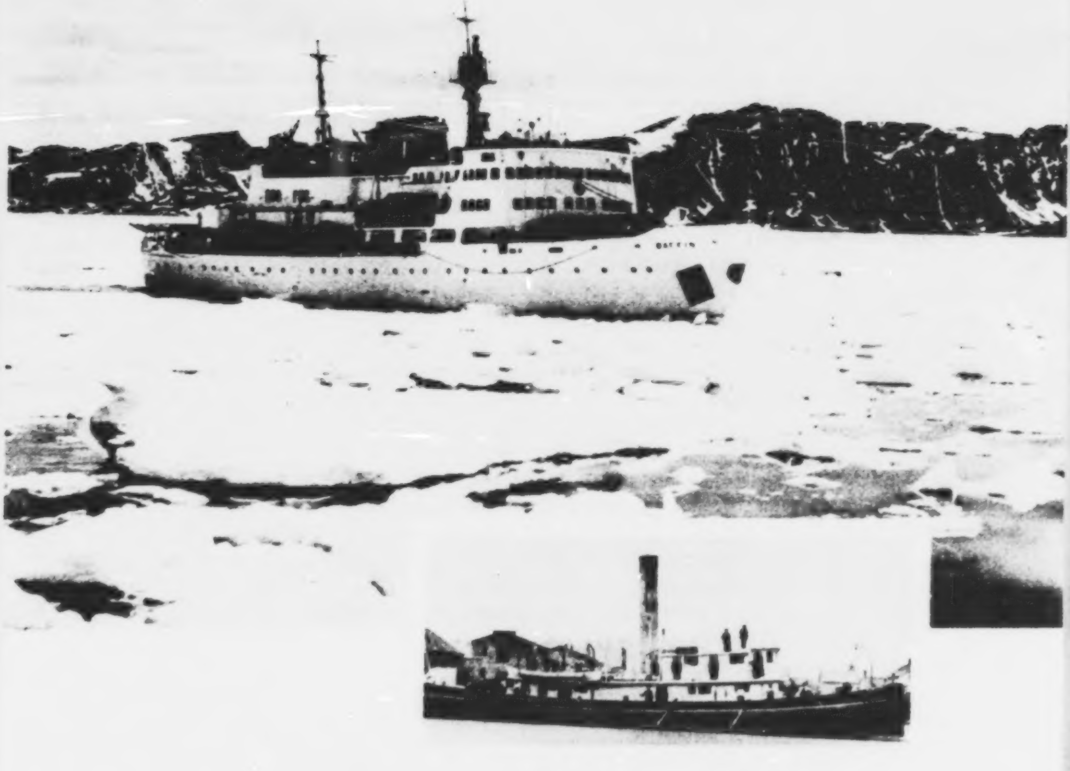


FIGURE 81. CHS *Baffin* in Frobisher Bay, compared with the first *Bayfield* (inset).

of British Columbia. For example, its work aided grain shipments through the port of Prince Rupert; of ore from Anyox and Alice Arm through Observatory Inlet; of forest products from Port Alberni; the salmon fisheries of the Skeena and of Pacofi; pulp and paper from Ocean Falls. But in the years after the war the work of consolidating and updating hydrographic charts became paramount. Generally the whole coast of British Columbia was surveyed with the aid of new equipment. The houseboats *Somass* and *Pender* were used to accommodate survey parties in the field. After Parizeau's retirement in 1945 W. K. Willis was placed in charge of Pacific Coast hydrographic surveys. In 1955 he was succeeded by R. B. Young.

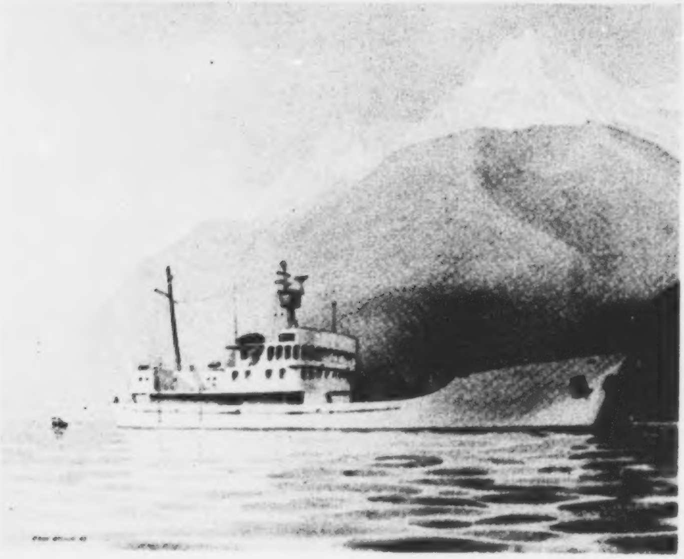


FIGURE 82
Sketch of CSS *Parizeau*.

In summary it may be observed that, in addition to the construction and maintenance of charts, the Canadian Hydrographic Service continued over the years to contribute substantially to the safety and growth of waterborne commerce and recreation in Canadian waters by the periodical publication of Sailing Directions, of Tide Tables, and of Water Level Bulletins. Since 1917 notable improvements had been made to navigational equipment. Loran (long range aid to navigation), a system by which ships and planes can fix their positions with exceptional accuracy, and radar came into more frequent use for position-finding. Depth-sounding apparatus became more sophisticated. By these and other means it became possible over broad reaches of the seas and over large inland bodies of water to navigate effectively otherwise than by reference to heavenly bodies and by the use of the leadline.

Before the end of the first half of the 20th century the entry of Newfoundland into Confederation enlarged the challenges facing the Hydrographic Service by adding to its charting responsibilities several thousand miles of coastline, including that of Labrador.

As Canada's tasks in these realms increased so also did the concept of the nation's place in the world of hydrography broaden. Early in 1951 Canada became a member of the International Hydrographic Bureau, a world-wide affiliation of hydrographic offices. Founded in 1921 the Bureau had its headquarters in Monaco. Through the services of this organization the exchange of information between maritime nations had been improved and expedited, standardization of chart features and of hydrographic publications generally increased, and periodic conferences of representatives of member nations held to discuss common problems. The Bureau is a consultative agency, seeking to induce conformity in hydrographic work methods and in publication forms, although its resolutions are not binding on its member states. As a result, however, hydrography has become one of the fields of human activity in which international coordination and cooperation are most extensive.

8

THE GEODETIC SURVEY OF CANADA: 1917-1947

"Of all these bounds, even from this line to this,"
—*King Lear*, Act 1, Sc. 1.

The Geodetic Survey of Canada had not reached the tenth anniversary of its informal beginnings* when the country became actively engaged in the First World War. By the end of hostilities 30 per cent of its staff members had enlisted for service overseas. The absence of these experienced officials combined with federal government wartime economies severely restricted operations of the survey organization. But under the continuing guidance of Director Noel John Ogilvie (1880-1967) the Geodetic Survey was able, within the limitations imposed upon it, to usefully perform both military and civilian functions during the wartime period.

Geodetic parties, in fact, contributed to national defence on both the Atlantic and Pacific coasts. A group under Ogilvie assisted naval authorities in the vicinity of Prince Rupert at a time when German cruisers were reported to be roving in that general area.[1] In Nova Scotia, in connection with the establishment of geodetic control for military mapping, the Survey extended its triangulation net from the Bay of Fundy to Halifax. The United States Coast and Geodetic Survey carried out a wire drag (soundings) survey at the head of Passamoquoddy Bay during the 1918 season to ascertain whether waters of the bay could serve as an anchorage for allied war vessels. A Canadian party was detailed to provide exact positions of numerous points to control the accuracy of the American survey. Incidentally an investigation of Campobello Island by Canadian geodetic surveyors disclosed not only the ruins of the building once occupied by Admiral Owen but as well Admiralty charts of the bay waters drawn by him.[2]

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*The official date of its founding is April 20, 1909 (Order in Council, P.C. 766) but types of federal geodetic survey work were being performed in Canada as early as 1905.

FIGURE 83
Noel J. Ogilvie (right), head of the Geodetic Survey of Canada, 1917-1946, with John M. Riddell, D.L.S., in Gatineau area, Quebec, 1931.

In the field season of 1918 a Canadian party also worked in close cooperation with the United States Coast and Geodetic Survey in carrying out triangulation work for the completion of a geodetic arc extending from the vicinity of Tacoma, Washington, to the point where the 141st meridian crosses the Yukon River. This task proved to be of primary importance to subsequent charting of the intricate coastal waterways of British Columbia. It also provided a sound basis for future mapping of the cities of Vancouver and Victoria.

Despite the exigencies of the times, useful triangulation data were supplied to a number of federal government departments and agencies for controlling the accuracy of maps and charts being issued by them. Beneficiaries of geodetic investigations included the Militia and Defence Department; the Hydrographic Survey of Canada, Department of Naval Service; the Chief Geographer's Branch, Department of the Interior; and the Geological Survey of Canada, along with the International Boundary Commission. On the provincial government side, the Quebec Streams Commission and the Toronto Harbour Commission were among organizations benefiting from these findings.

Certain tiresome yet not unnatural difficulties were faced on the home front by geodetic surveyors occupied during wartime on their lawful and constructive tasks. Louis Beaufort Stewart (1861-1937), chief of a reconnaissance party active in Nova Scotia during the 1918 season, incorporated the following terse comment in his official report:

"With everyone kept on the *qui vive* by reports of German submarines operating in Canadian waters it was not surprising that we should repeat the experience of other members of the Geodetic Survey staff and find ourselves regarded with suspicion by the people among whom we were working. This was troublesome on two occasions when it took the practical form of a refusal to all of us to board and lodging until assurance was given that we were what we represented ourselves to be."[3]

The objective of Stewart's party was to connect the main chain of triangulation in the Bay of Fundy and Minas Basin area with stations to be established near Halifax and then to extend reconnaissance of the main chain easterly to Prince Edward Island and Cape Breton Island. A preliminary survey had been made in this area by H. P. Moulton. Claude H. Brabazon was the geodetic engineer in charge of a party at the head of the Bay of Fundy during the 1918 season.

Stewart, an Ontario land surveyor, was commissioned a Dominion land surveyor in 1882, at the age of 21; he was resident of Winnipeg at the time. Five years later, while at Banff, Alberta, he became a Dominion topographical surveyor. In the year 1898 he was appointed a lecturer of Surveying and Geodesy at the University of Toronto. In 1901 he was appointed professor of those subjects and taught in that capacity for 31 years. But Professor Stewart never allowed himself to become cloistered in academic halls. He served as a surveyor in the field not only in the Maritimes but also in Labrador, in Alberta and in the Yukon Territory. He was an uncommon mixture of pedagogue and practical man. By his character and exceptional ability Professor Stewart exerted a challenging and constructive influence on the survey careers of many who had studied under him.

The Canadian Geodetic Society was formed in February, 1918. A glance at its first program of talks reveals not only the sort of subject that was of topical interest to members of the Society in the post-war period but as well the names of surveyors then active in geodetic and related surveying:

Reconnaissance	L. O. Brown
The Determination of Geodetic Datum	W. M. Tobey
Side and Angle Equations	D. J. Fraser
Service: The Motto of the Geodetic Survey	J. L. Rannie
The Fort Rupert Base	W. M. Dennis
Aerial Photo-Topography	H. F. J. Lambart
The Influence of Laplace Points	F. A. McDiarmid
The Canadian and United States Boundary East of the St. Lawrence,	J. A. Pounder
Survey of a Prehistoric Indian Village	W. J. Wintemberg
Field Artillery	G. S. Raley
City Triangulation	A. M. Grant
Map Production	J. R. O'Connell
Precise Levelling	D. MacMillan
Stereophotogrammetry	W. C. Murdie

In the meantime the motor age had dawned in North America and its revolutionary impact upon the mobility of the people of the continent was soon to be felt by Canadian surveyors. In 1919 the transition from the horse-and-cart era to that of the internal combustion engine was marked by the decision by survey authorities in Ottawa to make use in the field of railway motor cars* in place of railway hand-cars. The now more mobile geodetic surveyors, organized in five field parties, ran a total of 1,042 miles of precise levels in the season. The parties were under the direction of D. MacMillan in Saskatchewan, A. J. Rainboth in Alberta, G. F. Dalton in Ontario, N. H. Smith in British

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*A typical section hand-car fitted with a 4-h.p. gasoline motor.

Columbia, and G. E. B. Sinclair in Quebec. In the Maritimes parties headed by Claude Brabazon, Hazen P. Moulton, Professor L. B. Stewart and J. W. Menzies were engaged in reconnaissance work. Experience with the operation of motor trucks in the field indicated conclusively that important economies could be effected in transport costs where 'much running around the country' was required. For reconnaissance surveys a light runabout with a delivery box attached at the rear was favored. For tower-building parties a two-ton truck proved to be the most useful vehicle. One enthusiastic chief of party reported that his men were able to perform "200 to 300 per cent more work when provided with a car than when it was necessary to depend on trains and hired livery for transport."[4]

But all was not smooth progress for motoring zealots bound for survey work in the provinces. Moulton, whose assistant at the time was W. N. McGrath, reported for 1921 from the Maritimes that a provincial law in Nova Scotia prohibited the use of automobiles on country roads earlier than the first day of May. The impatient surveyors delayed their start on field work accordingly. The season's activities covered an area of about 5,000 square miles and was completed on Cape Breton Island. Moulton concluded his report to Ottawa on an exuberant note:

"The owners of land on which [geodetic] stations are located were very pleased to have observing towers erected, in many cases wishing that they were built higher on account of the beautiful views afforded by them. The scenery in Cape Breton is without rival in Eastern Canada." One is left to ponder whether head office in Ottawa was gratified or not over the inadvertent transformation of a practical and prosaic enterprise by government surveyors into a structure conducive to a greater exercise of the aesthetic and poetic sides of the Nova Scotian's nature.

Although use of the motor car brought about startling changes in ground transportation, an even more profound change was about to challenge surveying procedures, including geodetic work. With the introduction of the aeroplane, air survey photography and the transportation of parties and equipment over long distances took on new dimensions. In the 1920 season initial Canadian experiments in the photographic field were carried out in the vicinity of Ottawa. A Bristol Fighter (No. 433) with a Rolls-Royce engine and a LB (Mark 1) semi-automatic camera were employed for the purpose. In these try-outs photographs were taken from a height of 10,000 feet.[5]

In 1921 an officer of the Geodetic Survey of Canada, in charge of triangulation reconnaissance in the Fraser River watershed of British Columbia, was able, through the cooperation of the Canadian Air Force, to carry out part of his assignment by air. A triangulation net some 200 miles long was flown in the mountainous region eastward from Vancouver, the results being checked by ground visits to all stations.[6] Quite possibly this was the first practical application of aerial methods to geodetic survey operations in this or any other country.

In the use of a plane in 1928 over an area of 4,400 square miles between Senneterre and La Tuque in Quebec, it was found that costs of the survey operation in that area could be halved. Primary and supplementary stations were established during 17 hours of flying, spread over 10 days. Due to the relative inaccessibility of the region at the time, the same work would have required two seasons of operations if carried out entirely on the ground. Similarly on the Island Lake surveys related to the Ontario-Manitoba boundary surveys, planes made trips from Norway House each way within the span of a few hours. The one-way journey by canoe over the same distance normally required at least six weeks.

Flights were made in February and March of 1929 by officials of the Geodetic Survey to re-affirm the time-saving and cost-saving abilities of planes when used in geodetic tasks, not only in mountainous terrain but in less rugged country as well. Their verdict removed any doubt but that "much of the future triangulation reconnaissance in Canada, as well as transportation of field parties in certain areas, will be done by aeroplane." In all, more than 300 hours were flown for the survey in 1929 and, as a result of these novel operations and those of the previous season, it became clear that, especially in regions where roads were few and lakes abounded, geodetic reconnaissance, both general and detailed, could be accomplished by the use of pontoon or ski-equipped planes in the course of a few hours in contrast to weeks and months of laborious ground travel. After the selection of a triangulation station a tower-building party could be flown in and landed at the next point as required. Air operations also made possible quick and constant communications between chiefs of parties and Ottawa headquarters as well as between them and widely scattered units of surveyors in the field. Cabin monoplanes, accommodating five persons, were used at this time for geodetic survey purposes.

Difficulties were encountered in obtaining suitably detailed air photographs in these pioneer stages. Lenses of larger aperature, cameras of greater focal length, filters, special emulsions, infra-red photography and other equipment and supplies were subject to experimentation in the progressive application of stereo-oblique photography to the intervisibility of stations and the determination of the direction of lines. But even when ground checking of air survey work proved necessary, reconnaissance by plane, in areas where ground travel was inevitably slow, was decidedly more economical than a completely earth-bound operation.

Three major flying operations were carried out in 1931, one in Saskatchewan and the other two in northern Ontario.[7] By 1932, in various parts of Quebec geodetic reconnaissance, station preparation and angle measurements were undertaken, using aeroplanes as the sole means of transportation.[8] Checking of the results on the ground could be accomplished more rapidly because of information made available from the air concerning the position of hills and the best methods of approaching station sites. It was found that preparation and angle-measurement parties could be placed in the field one year earlier than if ground methods only were utilized. For ground reconnaissance the equipment normally used included a prismatic compass, protractor, ruler and map. For air reconnaissance a small apparatus, based on the plane-table principle, combined all these tools within one instrument. This consisted of a stand screwed to the deck of the plane. On a shelf a compass was mounted and at the top was a circular, revolvable plane table on which was placed the best available map of the area to be flown over. Economical results in aerial reconnaissance depended, in the last analysis, on a combination of expert piloting and proficient aerial geodetic engineering.

At this stage of national development it had become apparent that the ultimate aim of the Geodetic Survey of Canada was to lay down a network of primary triangulation extending from the Atlantic to the Pacific with branches of the network extending along both these coasts and at intervals into the interior. As this triangulation coverage progressed it was anticipated that surveys of lesser degrees of accuracy could be tied in with it and in time all would be shaped into one harmonious whole on a fully coordinated basis, affording the correct relationship of one part to another.

In this country growing recognition of the value of geodetic surveys was linked with the high competence and personal integrity of leading practitioners of the work in Canada. Outstanding among these men was John Leslie Rannie (1886-1954). His contributions to improvements in the performance of field instruments were noteworthy. Rannie was especially enthusiastic over the revolution in theodolite design introduced at Jena by Heinrich Wild and developed to the production stage in the early 1920s at Heerbrugg. When the T2 model reached Canada, Rannie quickly perceived that the small aperature of its telescope would mitigate against the widespread adoption in this country of the lightweight instrument in place of the rather heavy, cumbersome first-order theodolites then in use. It was partly owing to Rannie's advice to the makers that the T3 model, introduced in Canada in 1927, incorporated a larger telescope. Other improvements in this instrument derived from investigations in Ottawa by Rannie and his co-worker in this form of research activity, W. M. Dennis.

FIGURE 84. John L. Rannie.

Rannie, a graduate of the University of Toronto in 1907, was commissioned a Dominion land surveyor in 1909 and a Dominion topographical surveyor five years later. His professional career, in its entirety, was served with the Geodetic Survey of Canada and in 1947 he was appointed Dominion Geodesist. Three years later he became International Boundary Commissioner for Canada, retiring from the federal civil service in 1951. His term at the helm of the Geodetic Survey from 1947 to 1951 foreshadowed the rise to that post, in turn, of such able surveyors and administrators as J. E. R. Ross, J. E. Lilly, and L. A. Gale.

Triangulation work in Canadian cities had early become an important function of the Geodetic Survey. In the solving of modern engineering problems in urban areas, accurate topographical maps have always been considered a fundamental requirement. Geodetic surveyors had the training and ability to gather data beneficial to city mappers. As early as 1918 such work was being conducted by the Survey in Montreal and Toronto. Within a few years this type of activity had been extended to London, Quebec, Halifax, Saint John, Vancouver, and New Westminster. One great advantage of these operations was that if any points fixed by geodetic triangulation within city limits should be displaced or lost, these could be accurately re-established at any time.

A. M. Grant, a geodetic surveyor, reported in 1919 that "engineers of the City of Montreal have long felt the necessity for a complete new map of the territory embraced within city limits as well as of adjoining municipalities . . . . As the first requisite of such a map is triangulation control, the Geodetic Survey of Canada was asked if control could be provided. . . . The control points which were established were all selected so that their positions could be easily and accurately transferred to permanent marks in the streets. Where there were no sidewalks, marks consisted of copper bolts set in the tops of concrete monuments. . . ."[9]

In all this work there was a 'stepping down' from primary triangulations to shorter lines in and around built-up areas. Whereas in Montreal and London civic authorities asked for points to be accurately established on streets and sidewalks, in Toronto the City Surveyor requested that such stations be established at the top of prominent buildings. A number of years were required to complete the task of surveying London. Each year, however, showed a noticeable decrease in the unit cost of the operation as improvements took place in survey organization and methods. It was forecast by some experts in such matters that if aerial mapping could be employed to 'fill in' the interior of city blocks the cost of the cartographic operation could be reduced to about 75 per cent of the initial year's expenditure for the purpose, namely, by about $260 per acre. Publication No. 9 of the Geodetic Survey of Canada, 1921, titled *The Making of Topographical Maps of Cities and Towns: the First Step in Town Planning* aroused considerable interest in professional circles in Canada and the United States.

By 1926 it had become obvious to federal government authorities that with the rapid proliferation of engineering projects sponsored by municipalities and by private industry, there would be needed, even for points in some instances distantly removed from then existing industrial centres, precise data on latitude, longitude, and elevation above sea level. The Department of the Interior, Ottawa, recognized this trend by drawing up programs of work involving extension of levelling and triangulation nets of the Geodetic Survey.

The establishment of horizontal and vertical controls to meet survey requirements of a country such as Canada demands careful planning from year to year. The vast extent of the land area, the relative lack of highways, railways and navigable water routes, the heavily indented coasts fronting on three oceans, sparseness of settlement in many areas, all imposed formidable difficulties in the prosecution of geodetic work in the years between the two world wars. As recently, in fact, as the 1940s no continuous first-order triangulation existed from coast to coast on Canadian territory. A gap of about 600 miles persisted in the Lake Superior region of the trans-Canada chain or framework.

In the 1942 field season a special study was made by Cecil Herman "Marsh" Ney (1889-   ) of the Geodetic Survey concerning air navigation in polar areas involving

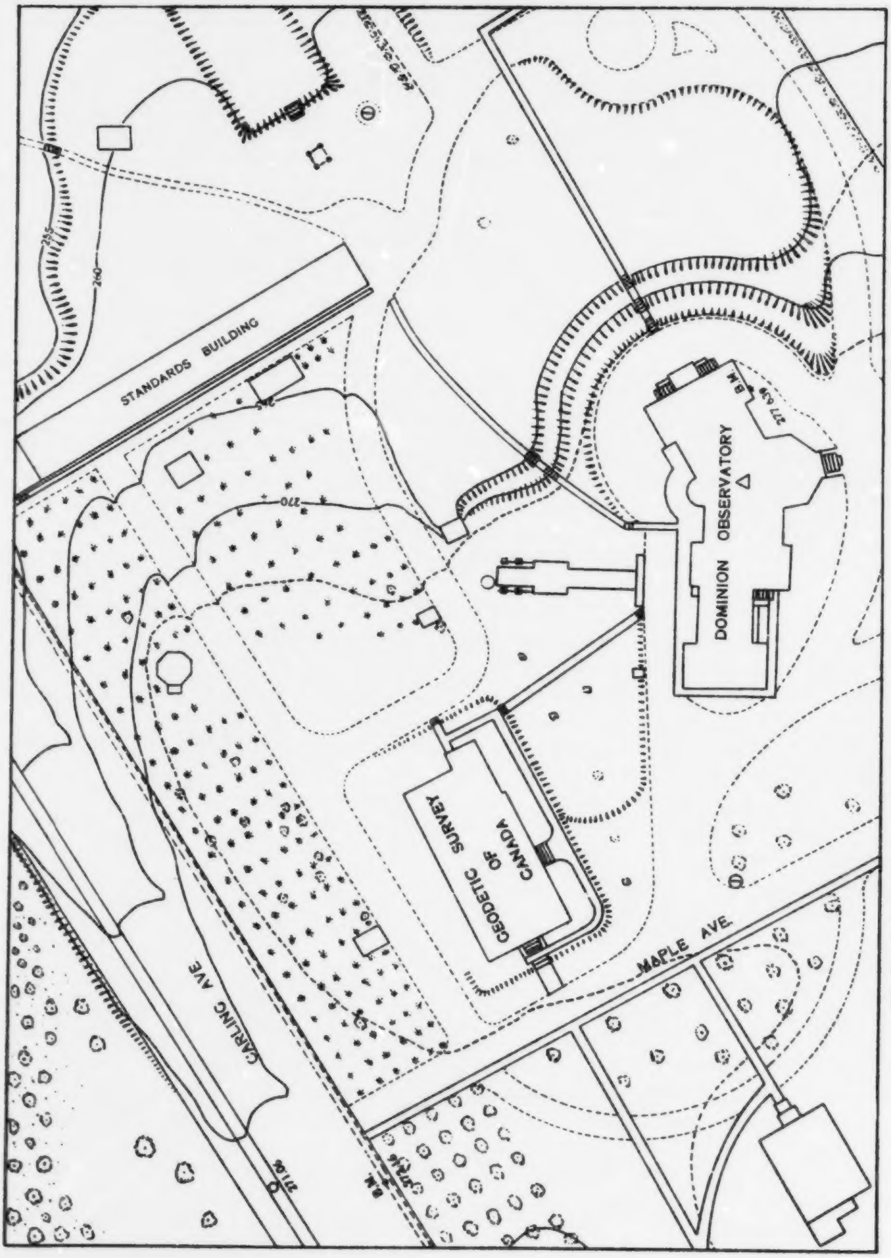
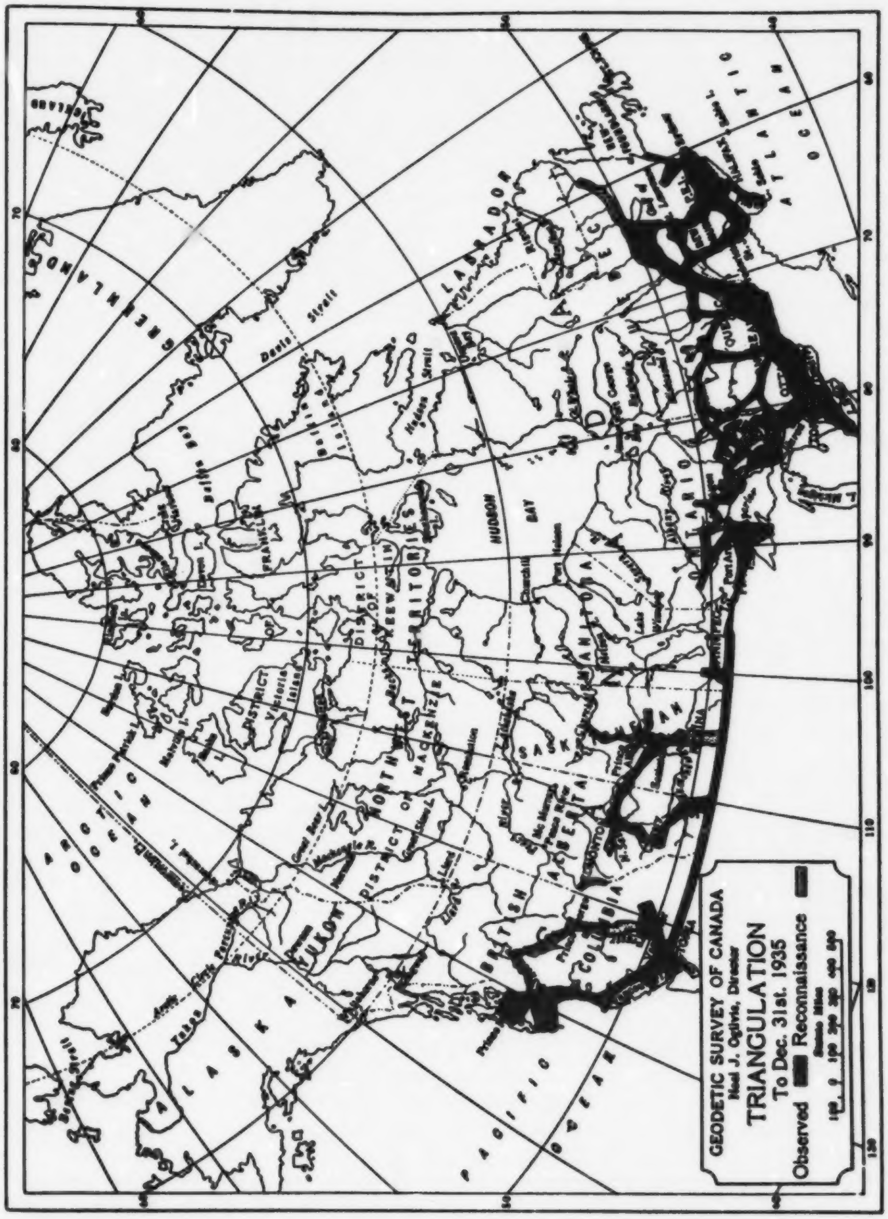

STANDARDS BUILDING
DOMINION OBSERVATORY
GEODETIC SURVEY OF CANADA
CARLING AVE
MAPLE AVE.
B.M.
255
240
270

FIGURE 85. Part of City Map (Ottawa) from Geodetic Survey of Canada publication No. 9, 1921.


GEODETIC SURVEY OF CANADA
Noel J. Ogilvie, Director
TRIANGULATION
To Dec. 31st. 1935
Observed
Reconnaissance
Statute Miles
ARCTIC OCEAN
PACIFIC OCEAN
ATLANTIC OCEAN
GREENLAND
ALASKA
YUKON
BRITISH COLUMBIA
ALBERTA
SASK
MANITOBA
ONTARIO
QUEBEC
LABRADOR
HUDSON BAY
Baffin Bay
Davis Strait
Hudson Strait
DISTRICT OF MACKENZIE
DISTRICT OF KEEWATIN
DISTRICT OF FRANKLIN
NORTH WEST TERRITORIES
Victoria Island
Great Bear L.
Great Slave L.
Bering Strait

MAP 3. Portrayal of triangulation work, Geodetic Survey of Canada, up to December 31, 1935.

compilation of all available weather and magnetic data for use on high-altitude flights in the Arctic. The study also included research in the development of methods for determining positions astronomically when the usual procedure was not suitable. Ney's adaption of a map projection for northern latitudes was a most important contribution to air navigation in those regions and it was probably for this achievement that Ney was made a Member of the British Empire.

Ney's survey career reflected the nature, scope and significance of Geodetic Survey activity in Canada during the period under review in this volume. Born in Bradford, Ontario, and educated in nearby Aurora, the town to which the Ney family moved when "Marsh" was ten years old, the youngster went on to the University of Toronto. There he was trained for geodetic survey work, selecting the then rather exotic courses of geodesy and astronomy. Professor L. B. Stewart was one of his instructors. Ney was fascinated by the science of precise measurements and by the surveyor's constant search for extreme accuracy.

During the months between college terms Ney took employment as a student attached to survey parties in the field. This exacting but useful apprenticeship prepared young Ney for the challenges ahead. During this period he served under such men as Ontario land surveyor James H. Smith in the vicinity of Cobalt, Ontario, as well as in Alberta: with Dominion land surveyor Wilbert Norrish in Saskatchewan; and with Guy Blanchet, D.L.S., in Manitoba. After a short span of service with the air force overseas Ney returned to Canada in 1919 and almost immediately joined the staff of the Geodetic Survey in Ottawa. In all, Ney served 29 years with the Survey, rising to the position of Assistant Dominion Geodesist. While in the field he worked on the Pacific Coast, along the Ontario-Manitoba boundary, the British Columbia-Yukon boundary, in the Eastern Arctic Islands and along the Mackenzie River.

An example of the risks so often faced by surveyors operating in the north country was experienced by Ney in the winter season of 1913-14 while he was an assistant on settlement surveys with Sid Fawcett, working along the lower Mackenzie River. With the onset of cold weather the survey party was forced to return upriver from Fort Norman by dog train. In the beginning the river ice was smooth but soon hummocky formations were encountered, reducing progress to an arduous seven miles per day. Between Fort Norman and Fort Wrigley the party ran out of food. Two elderly axemen, finding even that pace too exhausting, asked to be left in a tent with a supply of tea. The remainder of the party kept on the trail, drinking large quantities of tea, the only nourishment left to them, finally making it to Wrigley. Aid was sent in time to the encamped axemen. Sleeping in those latitudes in the open, with little or no solid food, in winter temperatures, proved to be the most rugged test endured by Ney in the field.

Despite its occasional rigorous conditions Ney always felt strongly attracted to the North and during his career witnessed a marked transformation in the manner of living there as the geodesist, geologist, hydrographer, and aerial photogrammetrist all helped in the process of rolling back the frontier in that part of the world.[10]

Notable advances made during the Second World War in the art of distance measurement by electronic means heralded the application of these ingenious methods of surveying to the tasks of civilian mapping. Radar was used for determining the height of a plane above the ground and this led, in connection with improved aeronautical charting, to the development of instrumentation known as the Air Profile Recorder. The invention and refinements of this new tool in air survey work will be considered elsewhere in this volume. Shoran, a name derived from the term "Short Range Navigation", was a system developed by scientists of the Radio Corporation of America for use in allied war raids and which proved readily adaptable to peacetime surveying tasks. This was one of the first radar systems developed during that war for use in the navigation of bombing planes and in the indication of bomb-release points. Shoran was first put into tactical military use in Northern Italy by the Americans late in 1944, with impressive results.

Soon after hostilities ended, a long-term member of the Geodetic Survey of Canada, John Earl R. Ross (1892-) recognized the feasibility of applying shoran methods to the solution of geodetic measurement problems in Canada. Late in 1945 the Associate Committee on Survey Research, under the sponsorship of the National Research Council of Canada, decided to institute a study in this regard. That was one possible use of shoran. Another possible function was that of providing the required horizontal control for air-survey photography in connection with the mapping of large areas. Late in 1947, at a time when Ogilvie was being succeeded as Dominion Geodesist by Rannie, Ross took an active and leading interest in initial field research near Ottawa, testing shoran as a tool in the provision of primary control for mapping purposes.

FIGURE 86. J. E. R. Ross.

Experiments were carried out in that year, and again in October, 1948, as a joint effort by the Royal Canadian Air Force, the National Research Council, the Army Survey Establishment, R.C.E., and the Geodetic Survey of Canada. These pioneer shoran-controlled air surveys, followed by a successful field operation covering parts of Manitoba and Saskatchewan in 1949, provided results the accuracy of which surpassed all expectations.[11]

In a geodetic sense the basic difference between the shoran method and normal triangulation procedure is that *distances* or *sides* of triangles are measured in the case of the former system, *angles* in the case of the latter. Whereas the sides, in ordinary triangulation networks, extend 10 to 50 miles, shoran lines vary from 100 to 400 miles in length. Horizontal control over large areas can thus be made rapidly available despite the nature of the terrain. The consistency of the results obtainable by these electronic measurements was definitely superior to that produced by astronomic fixation. For small-scale topographical mapping, such as that on a scale of 1:250,000, a shoran net could be used without alteration for control of air photography over areas previously devoid of survey control. The conviction grew in knowledgeable quarters that applications of the radar principle, such as shoran, could make a contribution to mapping in Canada approaching that of photography.[12]

In shoran, the distance between two non-intervisible ground stations was measured to an aircraft flying above the mid-point between the stations. Appropriate corrections were applied to allow for the geometric relationship between the curvature of the earth altitudes of airborne and of ground stations above sea level, and the effect of refraction. Calculations were then made to arrive at the distance between the two stations.[13]

Successful initial field operations employing shoran in 1949 were followed by intensive and extensive preparations for a wider use of the system in this country. By the season of 1953 a total of 11,000 linear miles had been shoran-surveyed and shoran-controlled air photography covered more than 100,000 square miles of northwestern Canada. By the following season 50 shoran station sites had been selected and so spaced as to provide control over 1½ million square miles of Canada north from existing triangulation nets to the southern bases of the Arctic Archipelago.[14] Mention should be made of the important services rendered in this realm of survey effort by the Dominion land surveyor Angus Cameron Hamilton (1922-) who was in charge of shoran reconnaissance activities in 1952 and of Canadian shoran operations generally during the field seasons 1954 to 1957 inclusive.

FIGURE 87. Angus C. Hamilton.

The name of J. E. R. Ross, whose long career had made such a noteworthy impact on Canadian geodetic surveying, became intimately associated with Canadian applications of shoran, which he did so much to promote in this country. He was largely responsible for the contents of two manuals describing geodetic procedures involved in shoran operations in Canada. Born in Elmira, Ontario, Ross attended high school in Kitchener, and then proceeded to the University of Toronto, graduating with honors in 1911 as a bachelor of applied science. His admiration for a half-brother, the Dominion land surveyor William F. Ratz, led Earl, as much as anything, into the profession. Ratz, who had played an important part on international boundary surveys from 1906 to 1909, died in Ottawa at the age of 25 years. Ross tells of his first applications to Ottawa for summer work on surveys, one sent to the International Boundary Commission, the other to the Geodetic Survey of Canada at the same time. Two replies came in the same mail. Opening first the letter from the Commission, Ross was downcast by the terse message from Dr. W. F. King, "We're very sorry that we cannot give you employment in summer work." Young Ross was so mortified and rebuffed that he had to be persuaded by his mother to open the second letter, also from Dr. King which read, "You are appointed to a summer position with the Geodetic Survey."

Ross went on his first field party in 1910 as assistant to the party chief, Dominion land surveyor Lindsay Osborne Brown. His pay as student was $1.35 per day, with 75 cents of that amount payable in the field and 60 cents withheld until the end of the season and then paid "if services satisfactory". Food and transportation, but not clothing, were provided for the purpose. This was Brown's first season in geodetic work also. Ross served in the field again as a student in 1911. In the following year he arrived in Ottawa to take charge of a geodetic field party. It was at this time that Ross received a memorable reprimand from his superior in the organization, C. A. Bigger. Apparently only one serviceable tripod remained in the survey stores in Ottawa and this happened to be too short to be useful to Ross. Bigger instructed him to go to the storeroom and get another tripod. Ross could not find another such item of equipment and reported accordingly, "Mr. Bigger, I looked there and couldn't find one." "Go and look again", was the tart rejoinder. "Mr. Bigger, there isn't one there but if there is, will you come and show it to me?" Bigger's pronouncement on receiving this challenging plea was a crushing one, "We are not, Mr. Ross, the servants of those we employ!"

Ross early showed high promise in his chosen profession. He was commissioned a Dominion land surveyor in 1913 and certified as a Dominion topographical surveyor six years later. Except for a period of active service with the Royal Canadian Engineers in the First World War, Ross served continuously on the staff of the Geodetic Survey of Canada from 1912 to 1957. At the peak of his service he was Dominion Geodesist and International Boundary Commissioner for Canada.

The science of navigation over land, sea and in the air has been a story of progress illuminated by the resourcefulness of individuals and marked by a notable evolution in instruments of measurement. From the cross-staff and sextant of the Middle Ages to the era of the compass and chronometer, followed by the advent of a variety of electronic devices, man's ingenuity has kept pace with needs of the times in the realms of exploration, surveying and mapping. The Second World War signalled the beginning of a remarkable period of technical advances in measuring systems and tools, improvements that brought pronounced advantages to the geodetic sciences. Base-line measurements for years before the war had been made, for example, by means of Invar tapes. But with Bergstrand's invention of the geodimeter, an electronic-optical instrument utilized to measure distances, it became possible for fewer men to measure longer lines in shorter periods of time than by the use of tapes. With the appearance in South Africa in 1956 of the tellurometer, capable of impressive daytime performances despite conditions of fog, smoke, haze, or rain, another distance measuring instrument became available to the geodesist.[15]

The invention of the tellurometer, progenitor of a new family of instruments employing microwave propagation to measure distances very precisely, opened an era of notable advancement in the world of survey instruments. The speed and efficiency of these new electronic devices contributed greatly to the science of geodetic measurements.

In physical geodesy the airborne gravimeter and the aerodist, in essence an airborne tellurometer, were soon to appear. The growth of satellite geodesy began to reveal fascinating opportunities for improving knowledge of the dimensions and shape of our planet. This has also given impetus to the development of instruments for use in predicting orbits of satellites and for radio tracking of these and other man-made objects that were soon to be launched into outer space in ever-increasing numbers by various nations engaged in probing the mysteries of that region.

The first known measurement of the earth's circumference at the equator, accomplished by Eratosthenes, was in error by 16 per cent. With the passage of intervening years and centuries since that historic calculation, a succession of ingenious instruments have continued to provide the geodesist with improved knowledge in his persistent search to ascertain the exact size, shape and weight of the earth on which we humans live, move and have our being.

"Not in vain the distance beckons,
Forward, forward let us range,
Let the great world spin forever
Down the ringing grooves of change."

9

EVOLUTION OF CANADIAN HIGHWAY SURVEYS

"To all the points of the compass . . ."
—*Coriolanus*, Act 2, Sc. 3.

In early Canada the waterways provided explorers, settlers, traders and officials with the swiftest, most economical and most comfortable form of transportation. The myriad lakes, rivers and streams of the northern half of North America offered mobility on a scale and with a facility unexcelled by any other mode of pioneer travel. The St. Lawrence River was the main thoroughfare of this extensive network, with its tributaries forming a veritable system of sideroads. In the maritime regions of the country pioneer settlers relied mainly on sea lanes as their chief means of communication, land roads being difficult to build and costly to maintain.

By 1773, for example, streets had been laid out in St. John's, Newfoundland. But a half-century elapsed before these were extended beyond the town's limits. The first overland road of consequence was that constructed from St. John's to Portugal Cove on Conception Bay. On the maritime mainland the first significant road was built in 1606 from Port Royal to a nearby creek, under Champlain's supervision. Not until a century later was another road of importance constructed in what is now Nova Scotia, namely, the 18-foot-wide highway from Halifax to Windsor, later extended to Annapolis.

New Brunswick followed the general pattern of riverbank roads characteristic of central Canada but progress was made in the newer province at a more accelerated rate. As early as 1801 the government of New Brunswick made grants in aid of construction to various localities under its jurisdiction. The first important roadway flanked the St. John River from Fredericton to the Bay of Fundy. By the 1820s a road linked Chatham and Shediac along the east coast. By the middle of the century New Brunswick possessed 1,269 miles of principal roadways as well as several hundred miles of sideroads.

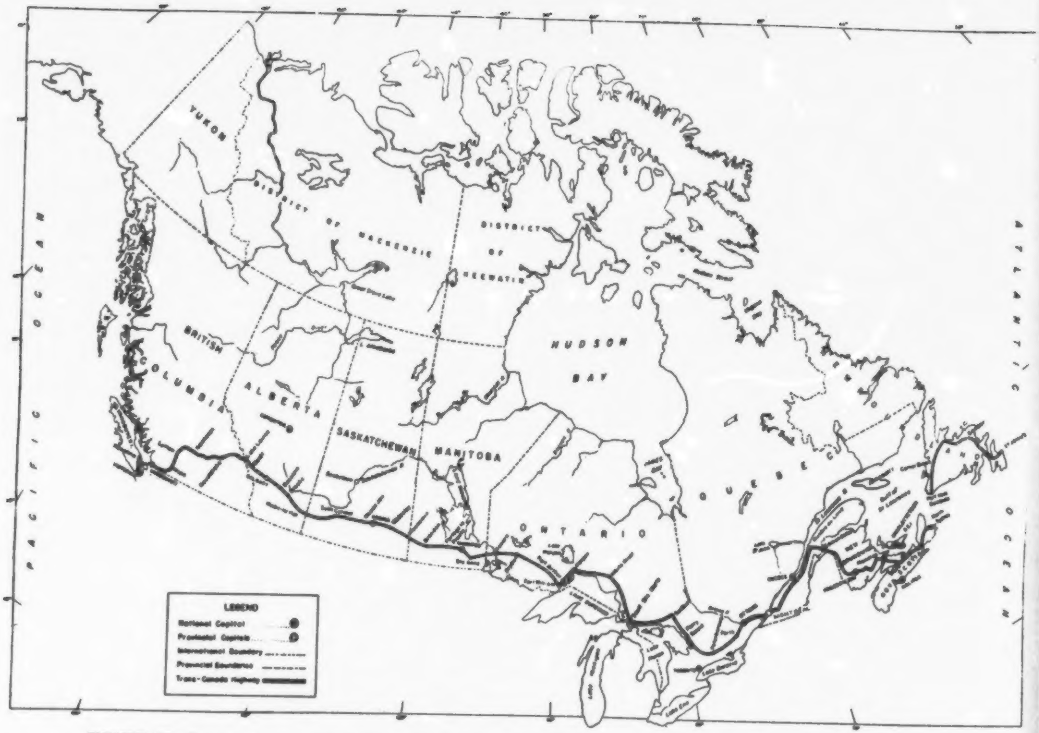

YUKON
DISTRICT OF MACKENZIE
DISTRICT OF KEEWATIN
HUDSON BAY
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
PACIFIC OCEAN
ATLANTIC OCEAN
LEGEND
National Capital
Provincial Capitals
International Boundary
Provincial Boundaries
Trans-Canada Highway

FIGURE 88. Route of the Trans-Canada Highway. (Map from G. B. Williams, Department of Public Works, Ottawa, 1957.)

Prince Edward Island authorities did not lag behind other maritime region governments in the matter of roadbuilding. From entries in the notes of surveyor Charles Blaskowitz we learn that in July, 1771, the Governor (of the Island) wrote to Lord Hillsborough advising that he had ventured "at his own risk to have a road laid out from Charlottetown to Prince Town, and although the surveyor avoided, by his instructions, all swamps, difficult rivers and steep hills, the road as measured was only three-quarters of a mile more than if on a straight line, and it is only 33 miles [in all]."[1]

Roadwork along the St. Lawrence River commenced with the emergence of a second tier or range of farms at the rear of the original river-frontage properties. In order to provide ready access to the St. Lawrence River from these back lots and to link them to each other the first primitive trails to be built by settlers came into existence. As horses arrived from Europe in increasing numbers, roads built under the direction of *grand voyers*, or supervisors of highways, began to appear along the banks of the river itself. One of the earliest of these highways linked Cap Rouge with the town of Quebec, a roadway eventually absorbed into what is now one of the city's principal traffic arteries, the Grand Allée. But prior to 1700 few roads had been built in New France. Actually, before the advent of the 19th century no comprehensive plan of highway construction existed in that part of Canada. The most important roads of the period were those providing access to the town of Quebec from Beaupré, Ile d'Orleans and other settlements in the vicinity. During the first decades of the 19th century the pace of roadbuilding quickened somewhat and several important sections of roads linking Montreal and Quebec were built along both north and south shores of the St. Lawrence.[2]

In British Columbia the period immediately following Confederation with Canada brought a change in emphasis in roadbuilding in that province. During the 1860s the chief objective in highway construction was to link the goldfields of the interior with tidewater. But in the succeeding decade the provincial government concentrated upon opening trunk routes through settled parts of Vancouver Island and in the farming areas of the lower Fraser River. In 1874 work began on the provision of a road from Ladner to Hope as riverborne traffic proved increasingly inadequate to meet mounting demands for service. Following the departure of the Royal Engineers most roads in the early days of British Columbia were built by statute labor working under an elected foreman. During the 1870s nearly half of all British Columbia's revenues were devoted to the construction and maintenance of roads and bridges.

In Upper Canada, later Canada West, although its government spent a substantial part of its meagre fiscal resources on the construction of a few trunk roads, the provision of many lesser roads was left to the settlers themselves. Highway development generally proceeded in rather piecemeal fashion. Asa Danforth, an American, was awarded a contract in 1798 to blaze a road from Kingston west along the north shore of Lake Ontario as far as York. As part of the agreement certain roadbuilding standards or specifications were to be observed. The highway was to be cleared to a width of 33 feet throughout its length with 16½ feet in the centre to be cut even with the ground. Bridges and causeways were to be 16½ feet in width and high enough above the water to lessen possibilities of destruction by floods. Slopes were to be gradual and safe yet wide enough for vehicles to pass thereon. By December, 1799, 63 miles of this type of roadway was opened for travel between York and what is now Port Hope. At this stage of development W. C. Chewett, the surveyor, was asked by the government to inspect the project. Chewett found that hollows needed filling, some hillocks needed levelling and that forest debris should be removed from various parts of the new highway. Bridges and causeways were found to be reasonably good with the exception of one bridge "which", it was found, "shakes or trembles" with a moving horse or carriage on it. Chewett also noted, with some asperity, that his survey ought to have been ordered and made earlier in the year "for when an inspector is almost frozen he cannot act as he ought to."

The general procedure followed in early days of roadbuilding in Upper Canada involved the employment of an explorer who walked ahead of the roadbuilders in order to roughly mark out its course. He was followed by two surveyors carrying compasses. Trail-blazers then used hatchets to notch trees on both sides of the marked trail while axemen chopped out the roadway between the indicated limits.

"Carriages without horses shall go
and accidents fill the world with woe.
Around the world thoughts shall fly
in the twinkling of an eye."

—Prophecy of Mother Shipton (1488-1561)[3]

In a number of ways the development of highways in Ontario over the years is typical of the growth of the road systems in the older-settled regions of Canada generally. From reliance on waterways and Indian trails, the early settlers, traders and the armed forces advanced to the use of blazed paths and winter roads. But when the snow cover disappeared under the warming rays of the spring sun, the rude and exceedingly rough pathways, cluttered with tree stumps, became virtually impassable. In swampy parts roadbuilders resorted to the corduroy treatment, covering the water-saturated, unstable ground with logs laid down alongside each other. These bone-shaking abominations were supplanted in time by graded but unsurfaced roads, ditched for drainage and crowned to shed excess water. Although at the time these highways represented substantial improvements in road travel, the gains remained strictly seasonal, offering poor progress in springtime and autumn months.

Increasing settlement imparted a marked impetus to the growing demand for better roadways. The need for more usable trade routes, for roads affording more rapid movement of troops and military supplies, for better postal service and improved mobility for those engaged in the administration of justice combined with a widespread desire for greater comfort in travelling, brought about the construction of more and more properly graded roads. In time this trend in public opinion resulted in the advent of toll roads, often surfaced either with crushed stone or with wooden planks.

During the period when railway building occupied the public limelight, roads in this country were more or less neglected. The appearance of steam-propelled vessels on the lakes and main rivers also temporarily distracted public and official attention from the pressing need for highway work. But with the arrival on the Canadian scene of the motor car in 1898 the role of the highway in the realm of national transportation once again became paramount. In that year the first gasoline-driven road vehicle to be operated in Canada, an American-built Winton, was purchased by John Moodie of Hamilton. By 1903 there were 220 cars registered in this country, all in Ontario. In 1907 Robert McLaughlin and his son, R. S. McLaughlin, formed the McLaughlin Motor Car Company in Oshawa. The first vehicle this plant produced was a McLaughlin-Buick.[4] These events ushered in a new age of vehicular mobility in Canada. Not even the popularity of transportation by air in more recent times has undermined the restored position in public preference of travel by roadways, although a commission appointed by the Ontario government reported in 1914 that farmers of the province "suspect that the days of the use of the motor car for mere pleasure are already numbered; that in another decade the joy-riding may be done in the air, and the automobile will be relegated to the purposes of sober labour . . ."[5]

As early as 1889 right-of-way surveys were occupying the special attention of some eminent Ontario land surveyors. "Field work", one of them stated, ". . . requires good judgment and experience, especially in towns and villages . . . The object is to find out the quantity of land taken from each owner and to obtain this the surveyor must be given the ordinary width required, also all extra widths and of course, in starting, the position of the located line should be fixed from some well-known point . . . The plan of the right-of-way should show numbers and other designations of town or township lots — the concessions, owners, with the area of each parcel to be taken, with the length along the located line of each parcel and the bearings of tangents and radii of curves."[6]

Up to the end of the First World War neither the volume nor the speed of motor vehicle traffic required departure from traditional road surveying practices. In general, methods employed in the planning, designing and locating of roads advanced relatively little in the 100-year period leading up to 1920. Reconnaissance surveys served to indicate the initial location line and possible alternative routes. These activities were followed, in turn, by preliminary surveys and final location surveys. Preliminary surveys involved the running of an accurate traverse line along the route selected as a result of the reconnaissance. Accurate levels were also run and bench marks established. From this data a basic map of the highway route was plotted and the final alignment of the highway projected. Then came the staking out on the ground of the finally determined road location. In all three stages in these early highway surveys in Canada, field notes, the compass, transit, chain, level and sometimes ground photographs played conventional roles. Where extreme accuracy was not essential the prismatic compass was occasionally employed in preference to the transit.

Within the 30-year span covered by this volume a notable transformation in the system of Canadian highways, along with related surveying and mapping, brought about profound changes in the social and economic climate of the nation. The problems faced and surmounted by highway surveyors and construction engineers may not be as much the concern of today's travelling public as their finished product, namely, smooth, hard-surfaced roads with easy gradients and good alignments. Nevertheless the outstanding contribution made by these specialists to a highly important feature of Canadian progress is a story that ought to be told.

Prior to 1917, when a section of the existing Provincial Highway System was first taken over by the then newly-formed Ontario Department of Highways (The Ontario Highways Act, 5 Geo. V, c. 15), several developments of key importance to highway builders and users had taken place. Toll roads had almost completely vanished from the province. The enterprising device of empowering private corporations to construct and maintain public roads, while collecting fees or tolls from their users, had proved a failure. Administration of highways and of highway building became increasingly centralized. In 1849 cities and towns in Canada West had been granted control of roads contained within their jurisdictional limits. In 1874 county councils were authorized to take over township roads. The formation of the new provincial department during the First World War foreshadowed an even greater degree of centralization as Queen's Park began to exercise a dominant influence and role in the provision of more and better public highways in Ontario.

Other aspects of the burgeoning motor travel industry benefited from this same system of trial and error. Revenues resulting from direct taxation of the road-user for highway construction had proved chronically inadequate for the purpose of financing such projects. A tax on each automobile registration turned out to be as ineffective as the imposition of tolls until the fee was based on the horsepower of the car engine and until some genius discovered that the bitter pill of taxation could be dissolved, with relative freedom from discomfort to the motorist, in gasoline. But at the same time the highway-user was beginning to benefit from increasing government services rendered in addition to road and bridge construction. Highway features were being marked by more descriptive road signs and, in 1923, the department issued its first road map. In the provincial road system of Ontario there were then 1,824 miles of hard-surfaced highways. In all Canada, at that time, there existed a total of 116,000 miles of improved earth highways and some 50,000 miles of various types of hard-surfaced roads. These figures represented, in rough terms, a doubling of mileages in these road categories over the corresponding totals in 1914.[7]

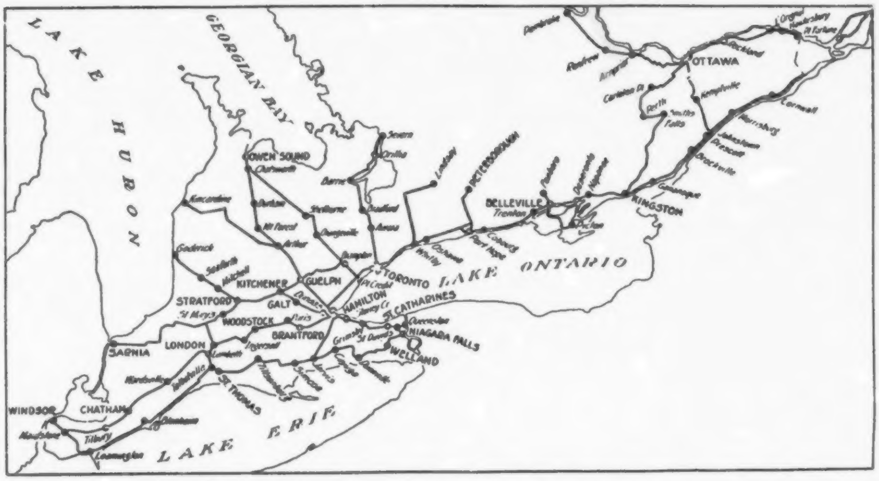

LAKE HURON
GEORGIAN BAY
OWEN SOUND
Severn
Orillia
Barrie
Lindsay
PETERBOROUGH
Kincardine
Bradford
Aurora
Goderich
Seaforth
Mitchell
KITCHENER
GUELPH
Brampton
TORONTO
LAKE ONTARIO
STRATFORD
St Marys
GALT
HAMILTON
ST. CATHARINES
WOODSTOCK
Paris
BRANTFORD
LONDON
Ingersoll
Grimsby
St Davids
Queenston
NIAGARA FALLS
WELLAND
SARNIA
ST. THOMAS
WINDSOR
CHATHAM
Tilbury
Leamington
LAKE ERIE
Whitby
Oshawa
Port Hope
Cobourg
BELLEVILLE
Trenton
Picton
KINGSTON
Gananoque
Brockville
Prescott
Johnstown
Morrisburg
Cornwall
Pembroke
Renfrew
Arnprior
OTTAWA
Rockland
Carleton Pl
Perth
Smiths Falls
Kemptville

FIGURE 89. System of provincial highways, Ontario, 1922. (Map from Ontario Department of Highways.)

Because the standard width of right-of-way for concession or sideroads in Ontario was 66 feet, practically all the highway surveys performed by the new provincial department were widening surveys. Under the 1915 Ontario Highways Act it was provided that every main road "shall have an allowance at least 66 feet wide and each board [of road trustees] shall have authority to widen such road or to adopt a more favourable route and [to have authority] to widen the allowance an additional 20 feet on each side *when such widening was considered desirable*." [author's italics]

When a road was taken over to form part of the new provincial system a preliminary route plan, on a scale of one mile to the inch, was filed in the registry office. On this plan the route was shown in red. A land plan was also filed by which the department acquired title to any land required in the widening process. This plan resembled a surveyor's standard plan but incorporated special information used in making the road survey. Between 1919 and 1923, under auspices of the department, several thousands of miles of hignway in southern Ontario were widened to 86 feet.[8]

In the 1920s the department issued instructions to field parties engaged in highway surveys which read in part:

"Notes should be made as to the size, type and condition of culvert span, waterway areas and types of bridges . . . If it is necessary in establishing lot corners to dig for stakes or stone monuments which are not found, note should be made of this, such as 'I dug here and could not find stake. . . .'

"On these surveys four-foot iron bars should be driven at frequent intervals so that the line may be easily re-established at any future date by . . . department surveyors or local surveyors . . . These iron bars should be driven well down to within six inches of the ground [level]. They should be put in by means of the steel tape and plumbobs should be used . . . Important stone monuments and landmarks should also be located with a steel tape and the exact chainage recorded to facilitate reproduction in case subsequent grading operations [should] destroy these points . . . It is not intended that iron bars should be driven at every property limit. If it is necessary to move back the fences, wooden stakes may be planted on property lines to facilitate this."[9]

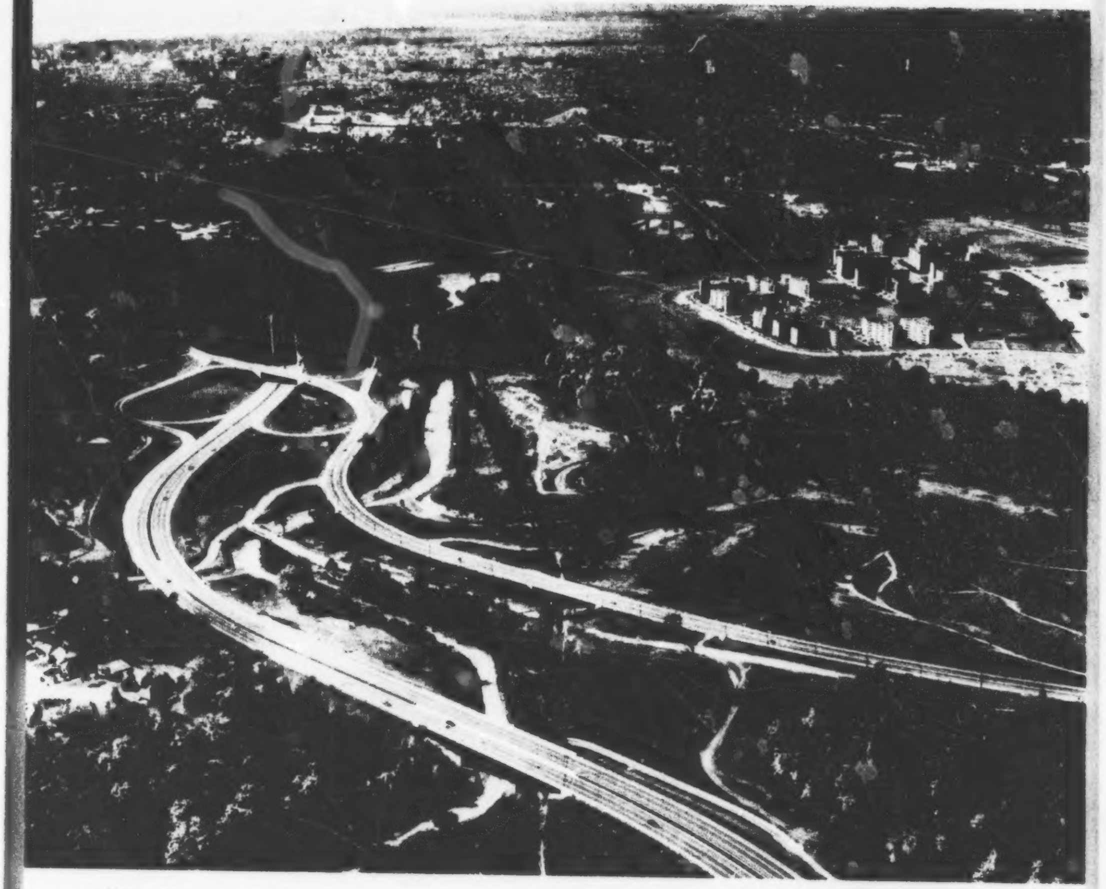


FIGURE 90. Pattern of highway development, Don Valley, Toronto, looking west to the Thorncliffe apartments complex, 1960.

Monuments were generally set one foot above the surface of the ground but in built-up areas the markers were set flush with the surface. The practice of driving iron bars on the limits of right-of-ways was not uniformly effective. Subsequent investigations revealed that in some areas up to three-quarters of the total number of bars disappeared within a relatively short period. Farmers, apparently, found the markers to be excellent crowbars. Fence builders removed them, road construction machines bent them out of shape and dealers in scrap iron found them to be a ready source of revenue. As an economy move the department experimented with the substitution of 5-foot-long concrete monuments.

During the period under review in this chapter highway survey parties in Ontario consisted of a large crew of 12 men or a smaller crew of 7. The latter group was

FIGURE 91. Along Toronto's waterfront in 1949.

composed of a qualified land surveyor as chief of party, assisted by a trained instrumentman who functioned in the combined roles of transitman and levelman. The remainder of the crew was composed of a front chainman, a rear chainman, a tapeman, a stakeman and a chauffeur. The larger group was divided into a location crew and a levelling crew. The former possessed, in addition to personnel listed in the party of 7, an assistant to the transitman and a property man. The levelling crew consisted of a competent leveller, assisted by his own rodman and tapeman. In addition to a transit, level, metallic tapes, heavy and light pickets, alloy chains and other implements these groups were equipped with the route plan, also a plan showing meridians of longitude and parallels of latitude, the location of geodetic survey bench marks in addition to details of local plans and surveys.

The objective of such parties was to locate and to mark on the ground the centre line of the proposed highway as well as its side limits and to obtain information and measurements essential to the preparation of a reliable plan of the route for registration purposes. In addition, surveyors were instructed to establish, by levelling procedures, bench marks along the route. These marks were never to be more than a half-mile apart. Complete profiles or cross-sections of the road were to be plotted at stated intervals. The property man was authorized to obtain the names of all owners of properties affected by or abutting on the proposed road. The relative positions of the road-

Highway development, including the Gardiner Expressway, up to 1962.

bed, ditches, embankments, culverts, bridges, railway and telephone lines and other man-made structures, as well as rows of trees were to be carefully noted and studied. The accurate location of the highway's centre line was indispensable to the maximum widening that could be achieved with the least possible expense. The locating of sharp angles along the route and at the crest of steep grades was to be avoided. The minimum radius of any curve in the route was set at 300 feet.

In 1930 the Ontario legislature passed an act (20 Geo. V, c. 10) under which the descriptive name of "Provincial Highways" was changed to "the King's Highway". With steadily increasing revenues derived from the gasoline tax and vehicle registration fees, millions of dollars became available from the provincial treasury for new highway construction. As a result of the depression period and the years of the Second World War an immense backlog of postponed road and bridge construction had accumulated in Canada as a whole. Roads with bases of poor quality, narrow, dangerous curves, steep gradients and obsolete bridges aggravated the ever-present problem involved in handling a gallon of traffic within a pint of highways. From the horse-and-buggy, dirt-roads era Ontario plunged, in common with the rest of Canada, into the age of multiple-lane, hard-surfaced highways, of overhead bridges, under-passes and the whole complicated system of traffic interchanges and cloverleafs that now constitute such distinctive features of expressways, throughways, freeways and parkways.

More intensive planning instituted well in advance of actual road construction, along with improved methods in highway building, came to be the order of the day. From the nucleus of Ontario's eight historic routes: Dundas Street, The Governor's Road, Longwoods Road, Kingston Road, Danforth Road, Talbot Road, Yonge Street and the road around the head of Lake Ontario to Niagara, there developed an excellent road system consisting of more than 85,000 miles of highways of which some 12,000 miles were under the direct control of the provincial Department of Highways. By the late 1920s, for example, congested roads linking the Niagara Peninsula to Toronto were unsuitable to carry properly the steadily increasing load of automobile and truck traffic. In 1931 work began on the construction of a new major highway in that area, christened "The Queen Elizabeth Way" and formally opened by King George VI and Queen Elizabeth in June, 1939.

The designing of highways became, in many respects, an exact science. Before any road-building project was undertaken on the ground, the actual and prospective flow of daily traffic to be accommodated was studied intensively. In addition to this traffic census, involving special attention to peak-flow periods, information was gathered on population distribution and industrial development in the areas to be served. Drainage patterns, soil physics, geological and topographical surveys data, sources of road-building materials, location of culverts and bridges, of road signs and survey monumentation were other factors considered in the planning stage. The fruits of all these careful preparations were better-located, better-built and safer highways.

Very early in the development of the new science Canadians discerned the special value of complete, accurate maps in connection with road reconnaissance surveys. At the outbreak of the Second World War Canadian surveyors, particularly in Ontario, were international leaders in experimenting with the use of aerial photographs in locating new highway routes. In the beginning few realized the revolutionary impact that would be made upon highway planning generally by the employment of this type of photography. The first trial project of this description was undertaken in 1931 in the area between Batchawana and Michipicoten during the preliminary survey of this Ontario section of the Trans-Canada Highway. Not until two years later, however, was the new procedure applied in earnest near Bancroft. Again, in October, 1938, a belt of land between Brockville and the Ontario-Quebec boundary was photographed from the air in connection with the locating of Highway 401. In 1942 the Toronto-Windsor section of the same project was flown for the same purpose. Elements of a Photogrammetry Section then began to appear in the Department of Highways. New equipment in the form of an epidiascope and a heavy brass stereoscope came into use in the Ontario organization about this time.

In the construction of the Alaska Highway in 1942 the United States Public Roads Administration, in cooperation with United States military authorities, made good use of Canadian progress in this aspect of photogrammetry. In selecting a route for that wilderness road with the fewest possible river and swamp crossings and with a minimum clearing of earth and rock grading, it was realized that normal road location by ground reconnaissance methods was much too time-consuming. At this point Ontario offered the services of its government surveyors, R. N. Johnson and K. H. Siddall. These men possessed a wealth of practical experience in locating highways by the use of aerial photographs. A Northland seaplane was placed at their disposal. Photographs of the rugged terrain, printed on strips, were examined in stereo pairs and viewed under a Fairchild prismatic stereoscope. The ability to interpret correctly the information made available through aerial photography for road location purposes has always been indispensable to the successful application of this procedure. In this case it was used to establish control points for the location of the Alaska Highway. A straight line was then drawn across the photographs to join successive control points. The next step was to transfer this projected line to the ground.

The size of each party engaged on field location varied with conditions of time and terrain. All lines were run by staff compass, rather than by transit, and simply blazed or marked for easy recognition by construction troops. As a rule each location survey party consisted of two men using a staff compass, five men on line-marking work, and two on chaining activities. With the aid given by aerial photography one regiment of United States engineer troops located and constructed some 230 miles of road between Fort St. John and Fort Nelson in eighty days.[10]

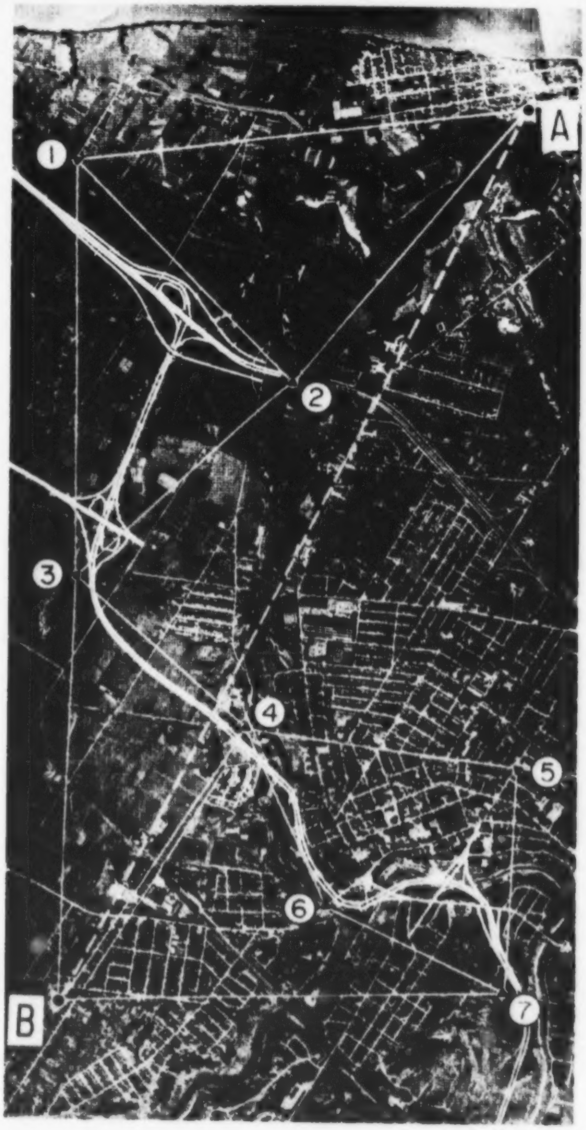


FIGURE 92
Example of triangulation survey control, construction of Ontario highways.

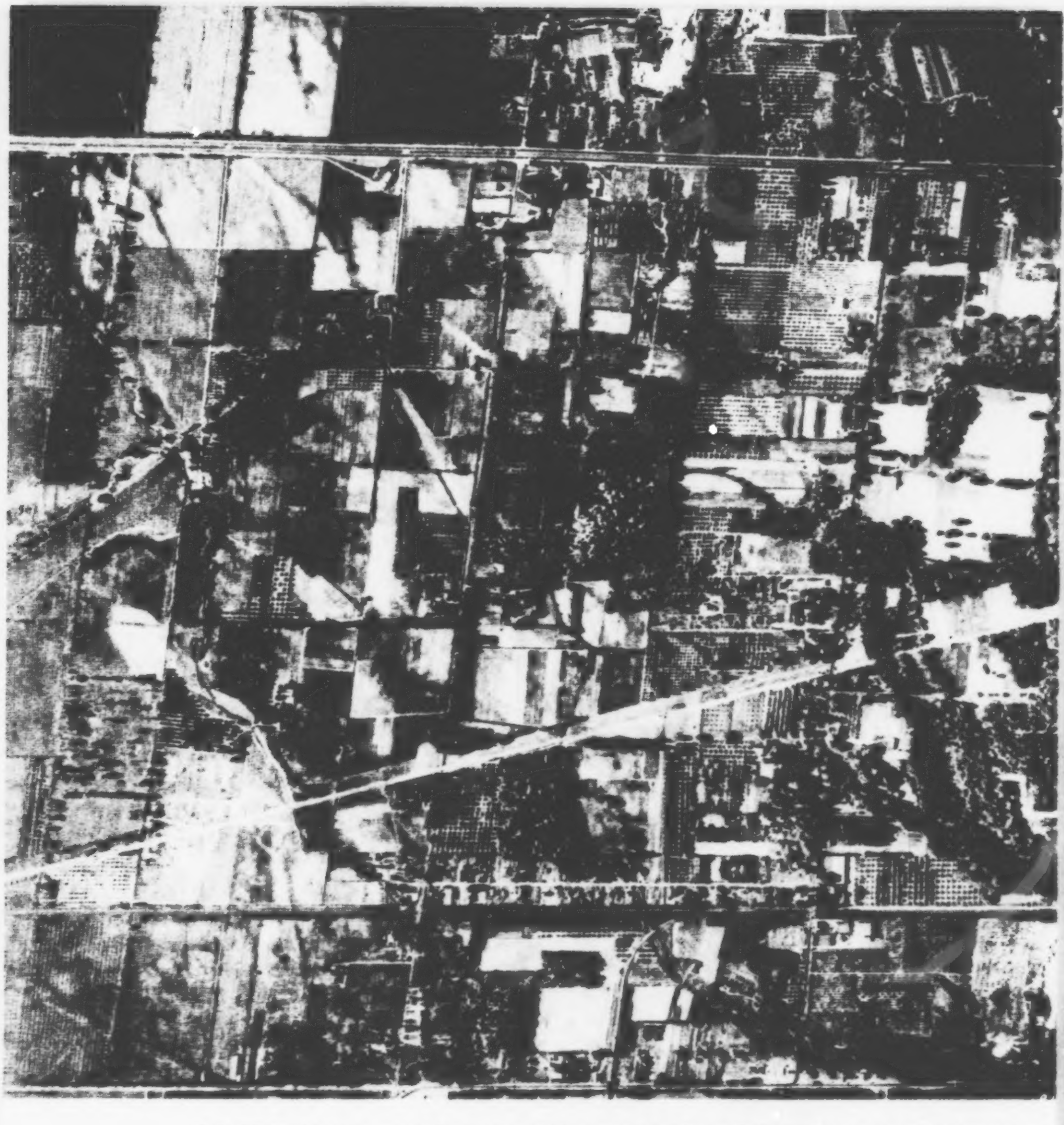
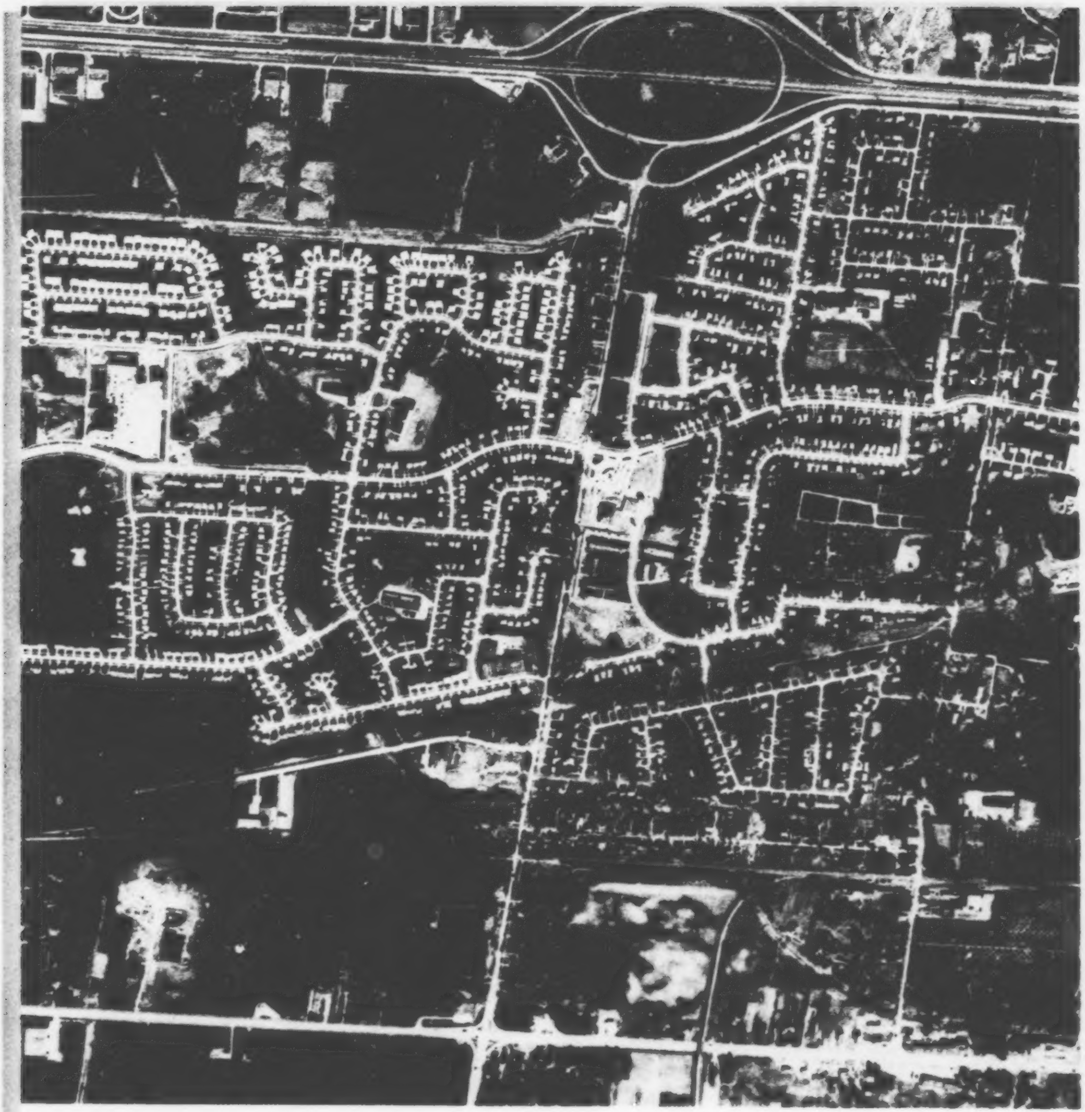


FIGURE 93. Clarkson, east of Toronto, in 1950, showing the Queen Elizabeth Way to the north (top of pictur

In 1943 a pronounced advance took place in providing control for plans produced from aerial photographs with improvements in the methods of taking measurements from air photographs and the provision of well identified field control. This enabled the photogrammetrist to control his scale not only along the line of flight but laterally as well. In late 1945 the Ontario photogrammetry group attracted well-trained army personnel in this special type of work. Soon the group acquired the status of a recognized section. The Department of Highways in 1947 purchased what was then the latest in photogrammetric equipment, the multiplex projector. Inventory photography resulting from its use commenced about this time in the province and proceeded until all Ontario



me view, 1968. Note the highway and urban development.

was covered. In those days a photogrammetrist was included in field parties. His task was to establish on the ground the line of highway determined by careful office study of the proposed route. In bush country, by constantly pacing, measuring, scaling and identifying natural features, he red-flagged the route, closely followed by axemen. In turn they were followed by instrumentmen, chainmen, levellers, and the contour section. Other types of new instruments purchased by the department included the Abrams Sketchmaster, a device for transferring photographic detail to base maps, and a Saltzman reflecting projector, an instrument capable of reducing or enlarging work in a variety of scales. Experimentation demonstrated that the greater the amount of photogrammetric control provided, the greater the accuracy achieved. In this manner the best possible route could be established, with marked savings in time and money, through areas where roadbuilding would be least arduous.

By 1945 highway survey procedure in northern Ontario had become a ten-stage process. Aerial photography of the area in which the road was to be located, establishment of control points, examination of photographs under the stereoscope, and selection of control points for the road location constituted the first four steps. Assembly of photographs on the drafting table was followed by the orientation of each photograph with adjoining prints to form a mosaic of the area. A straight line, joining terminal control points, could then be drawn across the mosaic. These three succeeding stages were followed, in turn, by a study of the photographs under the stereoscope to ascertain and mark on the prints the best location for the highway in relation to the straight line. A map was then made on the natural scale of the photographs depicting lakes, rivers, hills, and other topographical detail. Then the projected location line was transferred to the map. Finally, the map was placed in the hands of the location engineer, who established the projected line of highway on the ground.[11]

In southern Ontario, in locating a limited-access highway, both maps and aerial photography were used to fullest advantage. First, a four-mile-to-the-inch regional map was consulted. Then, on a mosaic of map sheets a line was drawn indicating the tentative course of the projected road. Using this product as a guide two-mile-wide strips of land were photographed from the air along the proposed route. Controls were then established on the ground and a topographical map was made on a scale of 400 feet to the inch. In establishing the line of highway on the ground the location engineer would make use of photographs on which the route had been marked, and by means of which he could more readily provide for railway grade crossings, stream crossings, and road intersections.

Highways in Manitoba received initial legislative recognition soon after that province was created. The 1871 Act Relating to Highways stated in part that "the main highway on the west side of the Red River from Lake Winnipeg to Pembina, and the main highway on the north side of the Assiniboine from Fort Garry to the western line of the Province, also the highway from Fort Garry to the Lake of the Woods . . . shall be known and designated as 'Great Highways' ". All other public roads in the new province were to be designated as 'public highways'. At a later date the width of the Great Highways was fixed at two chains. By 1950, however, highways in Manitoba generally were being constructed to widths of 150 feet and, in some examples of subsequent construction, much wider.

In 1880 all local highways in the province were turned over to the administration of municipalities. In 1910 an act provided for the appointment of a Highway Commissioner who was empowered "to disseminate information respecting the construction and improvement of the public roads and highways of the Province and consult with and advise municipalities with regard to such construction and improvements." A. McGillivray was the first to occupy this commissionership.

Two important acts were passed in the province in 1912, the Good Roads Act and the Highway Improvements Act. Under the latter statute a sum of $200,000 was set aside to aid municipalities in the improvement of main highways, then officially described as 'Great Main Roads'. These two pieces of legislation along with the 1910 act were replaced by the Good Roads Act of 1914, which provided that two-thirds of the cost of constructing 'Great Main Provincial Highways' would be borne by the province as well as one-half the cost of building new roads other than such main highways. Later on the province decided to pay to municipalities as well two-thirds of the costs of maintenance of main highways. In 1925 the category of 'Provincial Trunk Highways' was established. In 1943 the Good Roads Act of 1914 was repealed and under a new Public Works Act a Highways Branch was formed with authority over all provincial highways, drainage and other related works.[12]

Today, in Manitoba, it is a function of the Land Survey Office to conduct field surveys and prepare plans of Provincial Trunk Highways, other government roads and related projects. That office acts as the authority on land survey matters for the Highways Branch and the Chief Land Surveyor of the province is the authority responsible for closing public roads in connection with government road construction.

Up until the creation of the provinces of Alberta and Saskatchewan in 1905 surveying of roads was a function governed by Public Works ordinances. In 1880 it was enacted by authorities of the North-West Territories that all road allowances in townships "now or hereafter to be surveyed and sub-divided in the North-West Territories . . . shall be subject to the direction, management and control of the Lieutenant-Governor in Council . . . Whenever the Government of Canada receives notice from the Lieutenant-Governor that it is considered desirable that any particular thoroughfare or public, travelled road or trail in the Territories, which existed as such prior to any regular surveys, should be continued as such, the Governor in Council may . . . direct the same to be surveyed by a Dominion Land Surveyor and thereafter may transfer the control of each such thoroughfare . . . to the Lieutenant-Governor in Council for the public use of the Territories."[13]

In 1901 an ordinance of the North-West Territories provided that a [highways] commission may cause surveys of old trails to be made and that "such old trails, road allowances, diversions or new roads shall be laid out one chain [66 feet] in width."[14]

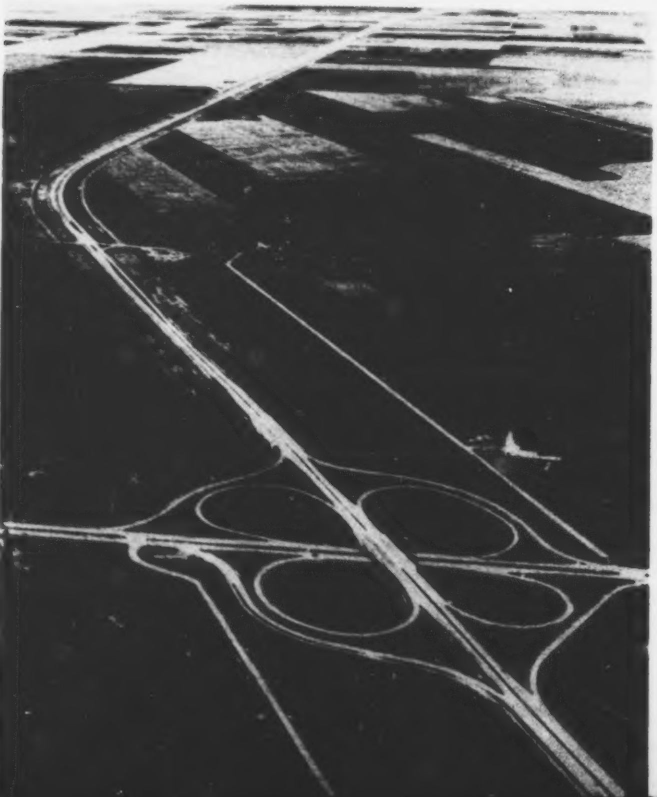


FIGURE 94
Pembina Overpass near Winnipeg, 1960.

These provisions were re-enacted by the first legislatures of Alberta and Saskatchewan in 1906, the same year in which the Torrens Land Titles system was established in those provinces, a system that included the registration of plans of roads. The Saskatchewan Land Surveys Act, 1913, c. 23, sec. 22, authorized road surveys. It is interesting to note that in the 1906 Alberta act "surveyor" was defined as "a land surveyor duly authorized under the Dominion Lands Act or any act to survey lands in the province." Dominion land surveyors continued to be eligible to perform surveys within the province until the passage in 1910 of the Alberta Land Surveyors' Act, c. 2, sec. 3 of that year, in which it was provided that "no person shall, within the province, subsequent to January 1, 1911, act as a surveyor of lands other than Dominion lands, unless he has been duly authorized to practice as a land surveyor according to the provisions of this act." In the next following section it was made clear that "duly authorized land surveyors" meant members of the Alberta Land Surveyors' Association, which had been formally incorporated by this 1910 legislation.

In Canada's western interior the practice has developed in recent years of having a Controller or Director of Surveys for the province, with authority over land surveys generally, as well as a Director of Surveys in the provincial Department of Highways and with a Chief Surveyor in the Land Titles offices. For example, in Saskatchewan, John Clair Traynor (1916-   ) whose grand-uncle Isaac Traynor (an Ontario and Dominion land surveyor) performed some surveying in Saskatchewan, served as Chief Surveyor in the Land Titles Office, Regina, beginning in 1949 and in 1956 became Director of Surveys in the Saskatchewan Department of Highways. In Alberta Charles Walton Youngs (1928-   ) served as Assistant Director of Surveys in the Department of Highways of that province for ten years until his appointment in 1964 as Director of Surveys for Alberta.

Any review of the development of highway systems in Canada would be incomplete without some reference to the career and accomplishments of Archibald William Campbell (1863-1927). Born in Wardsville, Ontario, young Campbell, following elementary schooling, apprenticed to Provincial land surveyor James A. Bell of St. Thomas. In 1885 Campbell received his commission as a Provincial land surveyor and entered upon the practice of his profession. Three years later Campbell addressed the annual meeting of Ontario land surveyors on the subject of highway bridges. Professor Galbraith of the School of Practical Science, Toronto, was so impressed by the paper that he incorporated its contents in part into an acknowledged text on the subject. In 1891 Campbell was appointed city engineer of St. Thomas and, in 1894, along with several other citizens of southern Ontario, organized the Good Roads Association of the province. At this time Campbell became associated with W. A. McLean, also an Ontario land surveyor. These two men formed a team that was active for some thirty years and which was vitally instrumental in developing a provincial highway system.

In 1896, when highway travel was still in the horse and buggy stage, the government of Ontario created the position of Provincial Instructor in Road Making. Campbell was appointed to this post, with McLean as his assistant. Four years later Campbell was named Commissioner of Highways in the province, again with McLean as his aide. In 1901 Campbell persuaded the Ontario government and legislature to enact The Highway Improvement Act, 1 Ed. VII, c. 32, under which one million dollars was made available for assistance in the building of roads.* Under the authority of this legislation

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*In 1919 this fund was increased to five million dollars (9 Geo. V, c. 18).

Campbell and McLean began organization of the County Road System. After serving in high civil service posts in both provincial and federal governments Campbell was named federal Commissioner of Highways in 1919.

It was during his term of office as Deputy Minister of Railways and Canals, Ottawa, that Bill No. 77, bearing the short title, The Canada Highways Improvement Act, was introduced in the House of Commons. This initial and novel attempt to enact a federal law under which subsidy payments from the national treasury would be made to provinces for road construction purposes, aroused keen interest not only in Canada but in the United States. This bill, however, never came into force. In that same year (2 Geo. V, 1912, c. 12) the Ontario legislature authorized the province to accept any such federal assistance, subject to certain specified conditions.

In 1919, in a second attempt by parliament, the Canada Highways Act (9-10 Geo. V, c. 54) was passed at Ottawa. Under this measure, similar in its terms to the original Bill No. 77, a total of $20,000,000 was made available for aid to the provinces in their roadbuilding activities. Commissioner Campbell administered this act and in the course of his duties conferred frequently with various provincial government highway officials. He prepared standard specifications for the several classes of highways defined in the federal legislation. Campbell worked diligently to devise and to urge the adoption of a uniform classification of roads across Canada.

In time the Commissioner of Highways became familiarly known from coast to coast as "Good Roads Campbell". A founding member of the Association of Ontario Land Surveyors as well as a founding father of both the Ontario and Canadian Good Roads Associations, Campbell's imagination, energy, and administrative ability distinguished his contributions to the creation and growth of these important organizations.

The story of advancement in Canadian highway construction in the period reviewed in this chapter reaches its climax in the renewal of progress toward the completion, at an aggregate cost of a billion dollars, of a paved Trans-Canada Highway from St. John's, Newfoundland, to Victoria, British Columbia. This formidable concept challenged the ingenuity, skill and resourcefulness of Canadian surveyors, mappers and highway engineers. In the accomplishment of this nation-building task much is owed to the vision and persistence of early promoters of this project, such as A. W. Campbell and Dr. P. E. Doolittle.

Thomas Wilby, in 1912, covered the distance from Halifax to Victoria in 52 days by motor car, bouncing over corduroy roads, splashing across mosquito-infested swamps, bridging creeks on improvised spans and surmounting steep slopes in reverse gear. In crossing long stretches of unfenced, trackless plains Wilby had little to guide him save a compass and the stars. At times heavy rains turned prairie mud into highly adhesive gumbo and compelled the determined driver to use railway tracks, from which he was prepared to leap for his life should the gleam of an approaching locomotive headlight come suddenly into sight. Although this and subsequent adventurous cross-country forays attracted widespread admiration, such isolated performances served more to stir sporting instincts than to create solid popular interest in the building of a nation-wide highway.

More orthodox efforts, on an organized basis, were exerted prior to the outbreak of the First World War to spur federal authorities into action on a Trans-Canada road link, but public support for such an ambitious project failed to crystallize until after hostilities had ended. After 1918 an unprecedented increase took place in motor vehicle registrations in Canada. This phenomenon was accompanied by swiftly-mounting demands from motorists for improved local and inter-regional roads.[15]

It was at this stage of national development that the Canada Highways Act, already mentioned, became law and, under its terms, provision was made for annual grants of money to provincial governments to aid in highway improvement work generally. Although the federal act did not specifically contemplate the building of a Trans-Canada Highway, regulations under it required the preparation by each recipient province of a program map of its main and market roads so linked as to form at provincial boundaries a condition capable of becoming, with the exception of one long stretch of territory north of Lake Superior, a nation-wide system of trunk highways.

In the years of economic depression leading up to the Second World War, federal spending in provincial fields was coordinated with expenditures under the Unemployment Relief Acts and included grants in aid of highway building work. In the terms governing these grants specific reference was made to the Trans-Canada Highway project and about one-half of the total highway construction grants was spent on the route of the national project as it was then designated.

As the post-war volume of long-distance travel, commercial and otherwise, grew apace, the establishment of a Trans-Canada Highway demanded ever-increasing attention. A federal-provincial conference on the subject was held at Ottawa in 1948 and, as a result, a Trans-Canada Highway Act (13 Geo. VI, c. 40) was passed by parliament at Ottawa in the following year. Two problems of administration immediately faced public authorities, namely, the need to obtain agreement on uniform standards of construction as well as agreement on a desirable route. At a federal-provincial conference held late in 1949 a set of minimum standards was mutually approved. In general

FIGURE 95. Trans-Canada Highway along the Bow River, Banff National Park.

the federal government was obligated to pay one-half of the actual cost of construction incurred by each province in providing its share of the coast-to-coast highway. The route within each province was to be designated by its provincial government, subject to federal approval. In essence the highway was to form the shortest, most practical, two-lane, all-weather, east-west road consistent with the needs of each province and with the national interest.

The agreement of 1949 called for a minimum width of right-of-way of 100 feet except where the highway ran through densely populated areas, in which case a minimum width of 66 feet would be acceptable. The paved portion was to have a maximum width of 24 feet, and a minimum width of 22 feet. The width of the shoulders on each side of the pavement was set at 10 feet, except where economy or the terrain dictated a lesser width, in which event a 5-foot shoulder width would suffice. The maximum curvature was not to exceed 6 degrees and, wherever possible, it should be reduced to 3 degrees. The maximum gradient was not to exceed 6 per cent as a general rule although where this was not economically feasible, gradients of 7 or even 8 per cent would be acceptable for short distances. Eventually, in total length the national highway extended over about 4,860 miles, some 140 miles of which crossed national park areas.[16]

Each principal region of Canada offers its own peculiar problems and challenges to road builders but in British Columbia generally and in Glacier National Park in particular certain difficulties occur in rather spectacular fashion. Ontario land surveyor J. E. Jackson reported to his provincial colleagues not long after the commencement of the Second World War that "it is expected the Big Bend Highway in B.C. will be completed for use in the summer of 1941 . . . marking the completion of a through route from Ontario's western boundary to the Pacific Coast around this great northern bend of the Columbia River." Mr. Jackson pointed out that many miles of this newly-completed highway were unpaved and stressed the fact that the need continued to be great and pressing for a transcontinental highway located wholly within Canada.[17]

Within a few years it was found that the Big Bend Highway, to conform to design requirements of the Trans-Canada system, would need to be constructed along its entire length of 196 miles. After careful investigations of alternative routes it was decided in 1956 to build a new cut-off stretch of the highway through famous Rogers Pass from Golden to Revelstoke, reducing the mileage of mountain road in this area by more than one-half.

Severe frost conditions have long plagued Canadian roadbuilding and maintenance engineers but in Glacier National Park, within which the preferred link was located, snow and its potentialities for danger and destruction constituted a major threat to the successful construction of any all-weather highway. This was a section of Canada replete with avalanche-forming conditions and formidable snow-removal problems.

As early as 1953 engineers of the federal Department of Public Works began to collect and collate data bearing on these factors, including extensive meteorological records. In order to devise a workable avalanche-warning system an Avalanche Research Group was organized. Four observation stations were built, two of them at high altitudes, in order to study the origins and behavior of both wet snow and dry snow slides. Out of these studies developed an avalanche-forecasting system as well as measures for stabilizing snow packs and the erection of snowsheds to provide the maximum practical degree of protection for the public travelling on that section of the Trans-Canada Highway.

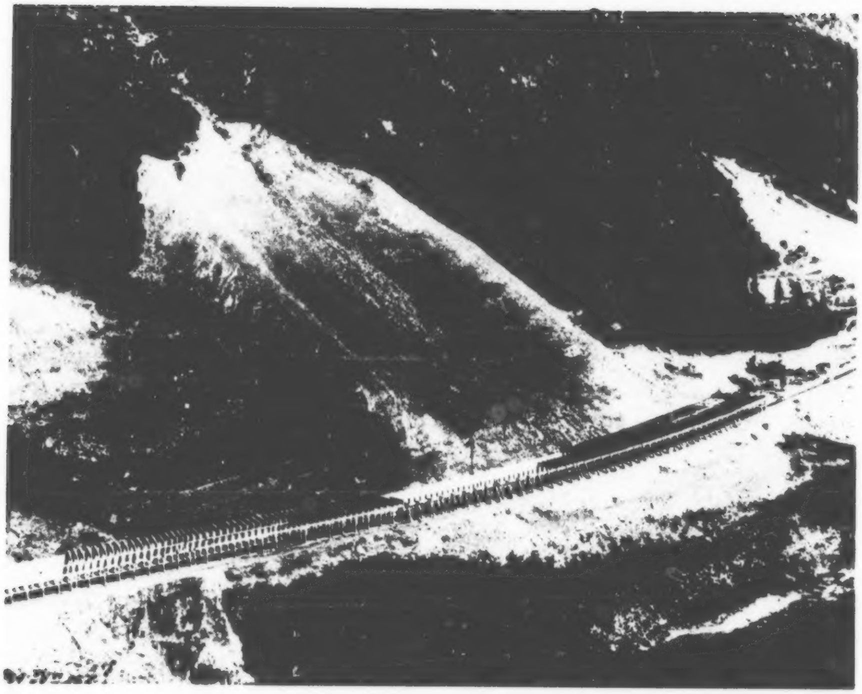

FIGURE 96. Snowshed under construction, Trans-Canada Highway, Glacier National Park.

Patrol work by research parties involved alertness and the exercise of snow craftsmanship of a high order in this avalanche-prone region. With normal precautions, however, tragedies are rare. Nevertheless one gruelling experience occurred when Bruno Engler, a man knowledgeable in the snow lore of the Canadian Rockies, was leading a ski patrol to the Mount Abbott observatory. When about 200 feet from the party's destination Engler suddenly detected a snow formation built up to a critical degree of steepness above them. He had time only to signal his companions to spread out when a slide of giant proportions began. Engler was quickly engulfed in the fast-moving mass and deposited on his back in spreadeagle fashion. His arms and legs were securely trapped and he had little air to breathe. Even worse, he had no reason to believe his companions remained unburied. However, at the time of the avalanche they were sufficiently far apart to avoid the main slide. Engler heard their footsteps as they searched above him and he managed to muster sufficient strength to shout. His cry was heard and when extricated, he was found to have escaped serious injury. But this was the sort of almost daily risk faced by those whose reconnaissance activities helped to ensure safety for motor-vehicle travel in this part of Canada.

Extensive snow packs were stabilized by the employment of artillery units of the Canadian Army. Mortar fire had the effect of releasing impending slides. By building a system of mounds that acted as brakes and by cutting out benches on slopes that

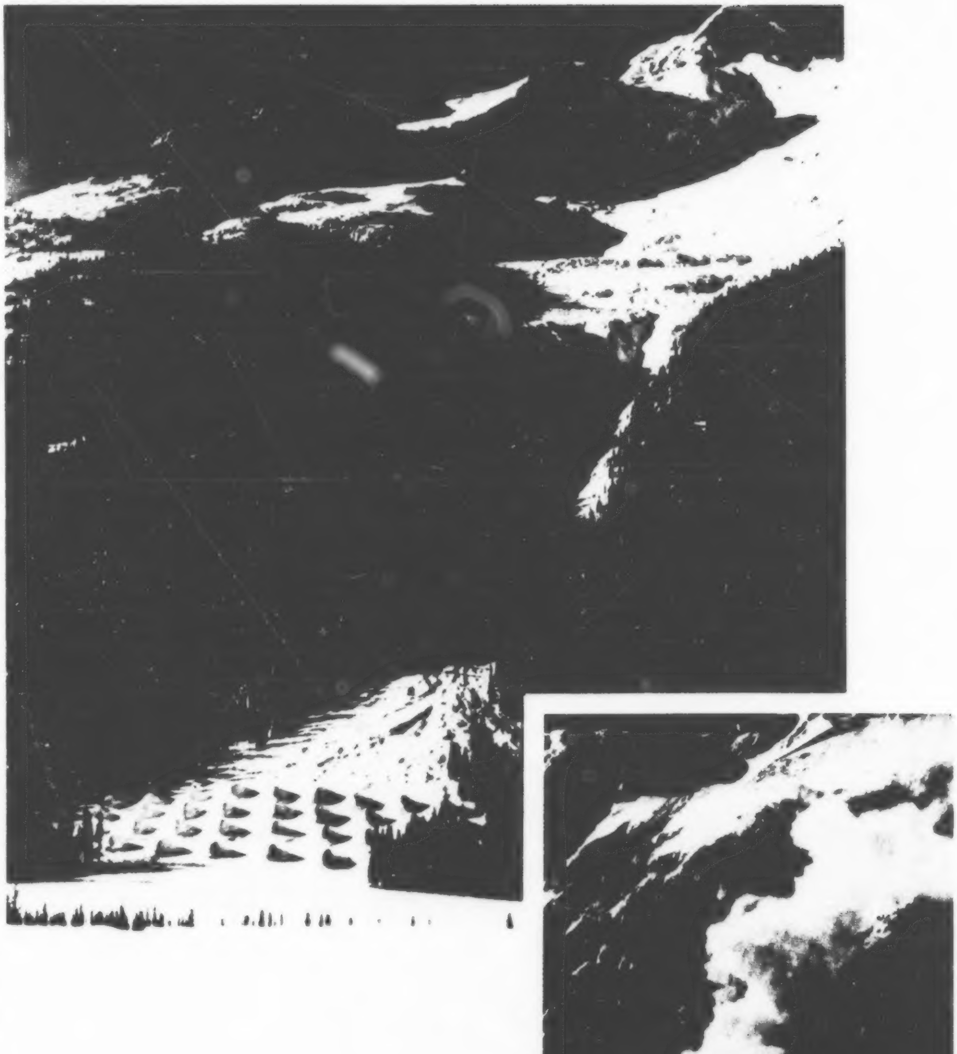

FIGURE 97
Built-up mounds in place to help break force of avalanches. Right: Snow avalanche in progress.

served as catchment areas, movements of vast bodies of snow were more or less effectively controlled. The pre-planting of explosives in critical areas proved useless because park bears displayed a keen appetite for dynamite. Most of the planted charges were eagerly devoured by grizzlies without any apparent ill-effects on them. Other types of diversion works, including snow dams, were erected by which a change in the direction of an avalanche could be achieved. Finally, in a few localities where other methods of control proved useless, costly snowsheds were constructed over the highway. The total distance sheltered in this way amounted to about a mile.[18]

During the 1917-1947 period the foundations for the final establishment of a transcontinental highway in Canada were well and truly laid and these made possible the completion, by the end of 1967, of one of the world's longest, continuous, all-weather roads. The finished Trans-Canada Highway constitutes an engineering as well as scenic marvel. It is a project of national significance in the construction of which surveyors and mappers have played indispensable parts. This unique road serves to promote economic expansion of the nation and to develop among Canadians a sense of oneness and a sense of common destiny.

Roads in Canada have become, in a real sense, renewable resources of the nation. Highways are valuable assets in the field of communications and encourage growth of industries and communities along their routes. They influence as well the growth patterns of the urban areas they serve. The evolution of road location and road construction techniques in Canada during the first half of the 20th century has, in fact, altered to a considerable extent the structure and way of life of our society. This arterial progress has promoted, if it has not created, ready mobility for the general public and a concomitant dissemination of ideas along with a marked growth of intercommunity, inter-provincial and international commercial and cultural activities.

GLOSSARY

Grade Separation: a structure designed to separate vertically two intersecting roadways, thus permitting opposing traffic to cross without impediment.

Control of Access: the condition where the right of owners or occupants of abutting land, or other persons, to a highway is controlled by public authority, e.g., entry ramps are built only at points where access is approved.

Limited Access Highway: a highway to which access is not provided except at certain closely controlled points.

Arterial Highway: a general term denoting a highway primarily used by through traffic, usually on a continuous route.

Expressway: a divided arterial highway designed for through traffic and on which full or partial control of access is exercised; usually it is a highway featured by grade separations at intersections.

Freeway: a completely grade-separated expressway on which full control of access is exercised. This term includes similar descriptive titles in use in other countries.

Parkway: an arterial highway for non-commercial traffic on which full or partial control is exercised and usually located within or bordering on a parklike development.

Traffic Interchange: a system of interconnecting roadways used in conjunction with grade separations, thus providing for an interchange of traffic between two or more roadways built on different levels.

10

CANADIAN MILITARY SURVEYING AND MAPPING: 1917-1947

Military topographical survey units, that relatively small but vitally important force operating within the orbit of army engineers, exist for the purpose of meeting defence mapping requirements in peace and in war, at home and abroad. Their functions include the training of personnel in surveying and mapping skills, the upkeep of mobilization stocks of maps, and the maintenance of a base plant capable of rapid expansion upon the outbreak of hostilities involving Canada's armed forces. This cartographical assignment, including map production and reproduction functions, was quite distinct from artillery survey duties which included, during two world wars, the fixing of Canadian gun positions and the location, by flash spotting (gun flashes) and sound ranging (supplemented by radar in the Second World War) of enemy artillery emplacements. Canadians were quick to perceive the value of surveys in warfare and to adapt various survey techniques to military operations.

The pronounced advantages of military map production and reproduction accomplished with commendable rapidity under actual battle conditions were firmly impressed upon Canadian army commanders and troops during the First World War. During intensive preparations, for example, leading up to the historic Canadian assault on Vimy Ridge in early April, 1917, and on the basis of aerial photographs taken by the Royal Air Force, the complex German defences were reproduced in full-scale detail in an area back of front lines. In this rear area, flags marked enemy strongpoints and tapes represented his trench system. Repeated rehearsals of attack procedures were staged. Large numbers of maps were provided. All essential targets were carefully catalogued with the aid of aerial photographs and arrangements were made to take immediate action upon the correlation of information obtained from powered aircraft and balloons as well as by flash spotting, sound ranging and ground observation.[1]

In the First World War Brig.-General A. G. L. McNaughton (1887-1966) evinced a special interest in improving the effectiveness of artillery bombardments, especially counter battery action. By 1918 he had been promoted to General Officer Commanding, Canadian Corps Heavy Artillery. McNaughton regarded the primary object of our counter battery work to be the protection of Canadian infantry from the firing of hostile guns. In earlier days soldiers in battle could actually see the target at which they were firing, even with artillery. During the First World War, however, the practice of indirect fire was developed and military grids became essential to the effectiveness of these operations.

FIGURE 98. General A. G. L. McNaughton.

Intelligence concerning enemy gun positions, their locations, number and the targets being fired on, was an indispensable factor in any successful counter battery activity. The final arrangement was to have two or more survey posts placed on commanding ground, equipped with the most efficient types of survey instruments and interconnected by telephone lines to a headquarters. As one post made its location of an enemy emplacement, the bearing would be reported by phone to the headquarters and then other posts would be advised of the finding. Following this advice telephone communications would be suspended while each survey post, observing the gun flash, corrected its bearing and pressed a key lighting a corresponding lamp at headquarters. When all lamps were lit simultaneously it could be assumed by the operator that all survey posts were fixed on the same flash. In the triangulation work frequently involved, bearings would be phoned in and plotted so that the location of the enemy gun could be determined with considerable precision, often to within five yards.

A second important function of surveyors in battle is that of sound ranging. A unit or section organized for this purpose consisted of a headquarters connected to three or more microphone stations along a battle-front, situated about 1½ miles from the firing line. When a listening post heard the report of an enemy gun discharging, a key was pressed, activating an apparatus at the headquarters on which sounds caught by the microphones at each station would be recorded. From the time intervals existing between the response of each microphone the location of the source of the gun report could be calculated. Under heavy enemy bombardment, however, these procedures, to put it mildly, became somewhat more complicated.

Other sources of survey information included powered aircraft, balloon observations and ground observers as well as intelligence officers. Gun flashes, particularly, were subject to efficient spotting from the air. Air photography was employed to reveal the exact position of enemy gun emplacements. Camouflaged positions could be detected by stereoscopic photography. As early as 1926 McNaughton prophesied that in the next war involving Canada "survey sections and sound rangers will become of increased importance but the greater part of our [artillery] fire will be based on information gleaned from air photographs."[2] This proved to be an accurate forecast. Canadian military surveyors, of course, performed the vitally important tasks of providing datum for pivot guns of Canadian batteries in action, enabling their firepower to be concentrated on a single target.

In the capture of Valenciennes in France by Canadian troops near the end of the First World War (November 1, 1918) strong points in enemy structures and trenches were located and mapped by Intelligence units employing air photographs and other survey information. In the Canadian Corps at this stage of the conflict cooperation between artillery and aircraft was particularly close.[3]

Following that war Brig.-General McNaughton, who had become Deputy Chief, General Staff, Ottawa, publicly noted that during the last 100 days of the hostilities in North-West Europe some 73,000 tons of artillery shells had crossed above the Canadian Corps in the direction of the enemy, nearly all of which ammunition had been fired on the basis of information derived from maps or from location data supplied by survey sections attached to Canadian formations. On the same occasion he remarked that "the making of maps and the work of surveyors in the field is an even more basic art in war than that of [military] supply." He pointed out as well that the only possible way in which a commander in the field could achieve a high degree of precise cooperation of the various formations under him would be by the use of maps, uniform in character, in his possession and the possession of his officers and troops. In addition he observed that in peacetime, when preparations had to be made against the eventuality of any war, one of the most important features was the production of military topographic maps "both for defence purposes and in case of any active operation in which troops may be called upon to take part." In short, the substance of the message McNaughton sought to convey was that no modern army could fight efficiently without the support of a competent, resourceful surveying and mapping organization.[4]

On May 14, 1918, in the closing months of the First World War the Canadian Corps Survey Section was formed, absorbing the Corps Topographic Section and the Intelligence Observation Section. This new, wireless-equipped Survey Section was attached to Corps Headquarters and, as noted in Volume One, was commanded by Captain W. R. Flewin, C.E. It was composed of 5 officers and 172 other ranks and the unit worked closely with the 1st and 5th Field Survey Battalions, Royal Engineers.

Its duties consisted mainly of flash spotting and the accurate fixing of Canadian battery positions. It was from this modest beginning that Canadian artillery survey regiments later developed. On April 12, 1919, the Corps Survey Section returned to Canada.[5]

At the conclusion of the First World War the (Military) Survey Division at Ottawa, formed under that title in 1906, was still engaged in the apparently endless task of depicting the topography of eastern Canada, mainly on its standard series of one-mile-to-the-inch maps. Motor transport was first used by the Division on ground control survey work in the summer of 1920. This increased mobility helped greatly to expedite activity in areas served by passable roads. In less well developed regions the horse remained supreme as a reliable aid to transportation of military surveyors and their equipment. In 1921, and typical of work being done at the time, a survey began of Camp Hughes Reserve in Manitoba, adjacent to the subsequently established Camp Shilo. About this time revisions of military map sheets covering areas in Ontario and Quebec provinces became necessary.

In the early months of 1922 a lengthy series of annual courses was inaugurated, designed to train Permanent Force personnel in surveying and mapping work. As vacancies became available the best students were transferred to the Survey Division which, at the time, consisted of 2 officers, 12 warrant officers and sergeants, and 23 civil servants. Other students were returned to their units to serve as map-reading instructors. In April of that year the Survey Division, after nine years of "exile" in the Branch of the Master General of the Ordinance, returned to the direct control of the General Staff (Director of Military Operations and Intelligence).* As a result of this transfer it took on the new title of Topographical Survey Section although its former name, Survey Division, remained in common use until 1925 when it was renamed the Geographical Section, General Staff, or G.S.G.S. in common terminology.

In the years immediately after the First World War, disturbing rumors circulated in the Canadian capital concerning the future of organized military survey work in Canada. Indications emanated from Privy Council Office, Ottawa, that the organization might be abolished and that the 1920-21 vote of funds by Parliament in its support might be, in fact, the final item to be included in federal estimates for the purpose. This threat was only removed after the most urgent representations had been made to the then Minister of Militia and Defence, Hon. Hugh Guthrie. At about this time, however, an era dawned in Ottawa in which a new spirit of cooperation flourished among the various federal departments and agencies engaged in surveying and mapping activities. In order to reduce duplication of effort as well as to promote greater uniformity of work among such military and civilian organizations, the interdepartmental Board of Topographic Surveys and Maps came into existence in 1922, on which the Department of the Interior, the Department of Mines, and the Department of National Defence were represented.† It was in that same year, by virtue of an act of Parliament (12-13 Geo. V, ch. 24) that the Department of National Defence was created in succession to the former Department of Militia and Defence. In the following year five Dominion land surveyors were loaned by the Interior Department to take one month's course in military survey practices and then to share in the summer field work of the Army's topographical survey. Under the arrangement entered into between Surveyor General Deville and the Department of National Defence, through its Minister, these Dominion land surveyors performed preliminary work with their military brethren on the Warwick Sheet

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*P.C. No. 874, April 26, 1922.

†P.C. No. 540, March 8, 1922.

(Quebec) and on the Ottawa Sheet in the interests of greater uniformity in federal map-making procedures.[6]

When Brig.-General McNaughton became Deputy Chief of the General Staff in the early 1920s he became profoundly dissatisfied with the traditional but more or less obsolete and time-consuming methods of map compilation and reproduction employed by the Geographical Section. He made a trip to England to investigate British Army procedures in this type of military activity. On his return to Canada McNaughton embarked upon a personal campaign to modernize the Section's map-making techniques. His innovating influence was soon felt in a number of directions. Early in 1923, for example, the Section was equipped with its first rotary offset press. This machine made possible the printing from zinc plates on offset rollers and the gradual elimination of the flat-bed system of producing maps. This acquisition served to speed up production and to reduce operating costs.

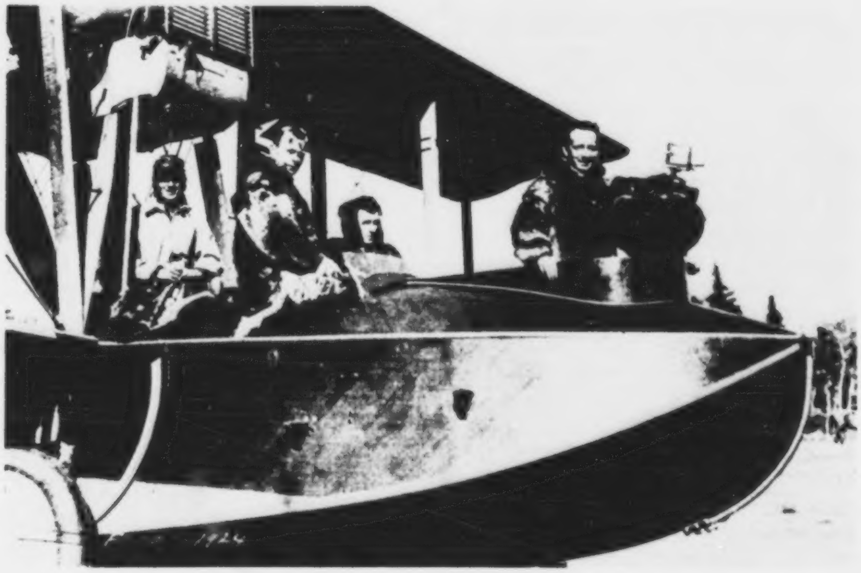

FIGURE 99. Canadian pioneers in air survey photography, Reindeer Lake area, 1924. Crew of Vickers Viking plane: (L to R) Sgt. A. Milner, mechanic; S/L Basil Hobbs, D.S.O., pilot; R. D. Davidson, navigator; and F/O J. R. Cairns, photographer.

McNaughton's continuing interest in the adaptation of aerial photography to survey work was immensely helpful in bringing about early developments in that field in Canada. During the 1924 field season the Royal Canadian Air Force embarked upon an experimental program of vertical photography covering some 40 square miles at an altitude of 6,000 feet. From this time onward steadily increasing use was made of aerial pictures in military mapping in this country. McNaughton, in fact, felt that the most important leap forward in map and chart production since the invention of printing had been accomplished by practical applications of aerial photography to surveying and mapping generally.

Before long the improved output of military maps of the Geographical Section began to attract international attention and comment. Karl Baedeker of guide book fame stated in his edition on Canada, "Of the detailed maps of the various parts of the country on larger scales there must be first mentioned the excellent topographic maps published by the . . . Department of Militia and Defence in two editions." A senior officer of the War Office in London, England, reported that "the maps sent me [from Canada] are a very creditable production. The blacks are excellent, beautifully sharp, and dense in colour. I have shown the maps to our draughtsman and my chief and they consider the work is above our production, and I personally feel that your chief and others for whom you reproduce work must feel a touch of personal pride when they see such results from a new press and a new process."[7]

By 1924 some 30,600 square miles of Canada had been surveyed and mapped by this military organization, with about 9,000 additional square miles in various stages of completion. A total of 90 sheets in the military standard one-mile-to-the-inch scale had been published by the Geographical Section. When other federal departments had produced good topographic results such work was incorporated into these military maps and, conversely, the departments made use of military surveying and mapping.

Of all the steps taken by General McNaughton in advancing the status and work of the Geographical Section, General Staff, the most significant was his success in attracting one very promising recruit and youthful First World War veteran to this military survey organization. McNaughton had become aware of the special abilities of Captain E. L. M. Burns after assigning to him "the task [as the General put it] of applying the Euclidian principle to air survey work." Few men have made a contribution to the progress of Canadian military surveying and mapping that could match that of Eedson Louis Millard Burns (1897-). He rose to national and international prominence initially as an able commander of Canadian Army formations in the Second World War and, subsequently, for his leadership of United Nations truce organizations and also as Canadian representative at disarmament conferences. But he first came to the special notice of military and civil authorities in Ottawa as a gifted mathematician and as a man keenly interested and highly proficient in military surveying.

Born in Westmount, Quebec, in central Montreal, young Burns received his higher education at Lower Canada College and at Royal Military College in Kingston. At the age of 18 years he was commissioned in the Royal Canadian Engineers and served in France during the First World War, winning the Military Cross in 1916. After the war's end he joined the staff of Royal Military College as an instructor and later was appointed General Staff Officer, Surveys, Militia Services, Department of National Defence, with the rank of major. In 1931 Burns was appointed officer in charge of the Geographical Section. In the early 1930s, in response to the steadily expanding need for aerial photographic surveys in Canada several committees were established in Ottawa to direct and to coordinate all such federal government activity. An interdepartmental committee, under Dr. Charles Camsell, exercised general control over operations. Officials of the Topographical Survey (Interior), under the chairmanship of Dominion land surveyor, Athos Maxwell Narraway, investigated new uses of aerial survey photographs. At the National Research Council another body, concentrating on survey research work, encouraged development of new methods of producing reliable air photographs for mapping purposes. Narraway, who served also as secretary of the interdepartmental and National Research Council committees, provided the essential liaison link between all three bodies. Soon Burns was immersed in committee work in Ottawa

FIGURE 100. Lieut.-General E. L. M. Burns.

becoming, in short order, convener of the Subcommittee on Mapping Methods, operating under the Associate Committee on Survey Research, National Research Council.[8]

The strong, aggressive leadership given the Geographical Section by Major Burns is revealed, among much other evidence, in the records of a meeting held in Ottawa on September 2, 1932, on the subject of "Compilation of Area Maps for Air Navigation". In attendance were Major-General McNaughton, J. A. Wilson, A. D. McLean, Col. H. H. Matthews, Major Burns, Surveyor General Peters and A. M. Narraway, Chief Aerial Surveys Engineer. Apparently there had been a developing conflict of opinion over whether or not the Geographical Section would compile and print a certain map sheet or sheets relating to the Montreal area.

The Surveyor General explained that the Topographical Survey (Interior), under his direction, was about to issue a series of 8-mile-to-the-inch maps of the National Topographic Series to replace the Chief Geographer's Series then going out of print and that this publishing venture was a legitimate function of his organization. A start had been made on Sheet 31 S.E. He considered these small-scale topographic maps to be the logical bases for air maps of Canada, provided that necessary aviation information was overprinted on the maps.

This proposal met with general agreement at the meeting but the military representatives present pointed out that the demand for air navigation charts, especially those intended for guidance of trans-Atlantic flights, was urgent and that the Geographical Section was manned, equipped, and ready to render help in meeting this requirement. In the end it was decided that Surveyor General Peters and Major Burns should consult together as to style and conventional signs to be adopted in the 8-mile-to-the-inch series. If they could not agree on the selection of any particular sign, the matter was to be referred to a superior authority or to the government department directly concerned. Any maps produced were to bear the usual titles employed by the Topographical Survey (Interior) and distributed to the public by that organization. The fact that the compilation and printing had been done by the Geographical Section, General Staff, was to be noted at the foot of each such map.[9]

The Subcommitte on Mapping Methods concentrated its efforts on the development of forms of aerial photogrammetry peculiarly applicable to Canadian conditions, including the need for small-scale maps that could be produced efficiently and economically. This body, on which Dr. L. E. Howlett also rendered distinguished service, sponsored the construction of an instrument for extending control by radial intersection through strips of air photographs. The principles of the resulting radial-stereoplotter were worked out by Burns who, by 1935, had risen to the rank of Lieut.-Colonel. The design and construction of the first model of the machine was undertaken at a cost of $3,400 at the National Research Council by R. H. Field, and his staff in cooperation with Burns and with the advice of Dominion land surveyor, Robert B. McKay.

The original model of the plotter was delivered to the Geographical Section in January, 1935. Photographs taken from the air at Meach Lake, near Ottawa, and along the shoreline of Great Slave Lake were tested in the plotter and, as a result, certain modifications of the instrument were recommended. "The results of these experiments", Burns commented at the time, "are considered to be very satisfactory. While no new discoveries in the technique of air photo survey are claimed, it has been shown that methods devised and partially tested by experiments elsewhere can be practically applied in Canada and that great advantages in speed, accuracy and economy of effort in topographic mapping can be obtained."

In the same year Lieut.-Colonel Burns brought to the Section an instrument of German origin, the Zeiss multiplex aeroprojector, the first instrument of the kind to be imported to Canada. By means of this device a strip of overlapping air photographs could be viewed and measured with precision in three dimensions. Only fifteen years earlier the first instruments for automatically plotting aerial photographs under stereoscopic observation had been built. One great advantage of this highly significant improvement was that, with the multiplex, all of the area being mapped could be seen at one glance in the fullness of all its topographic detail. It was possible, therefore, for the topographer to bring all parts of his work into harmony with the various land forms depicted.[10] At about the same time the Zeiss firm in Jena brought out a new wider-angle aerial camera lens, thus providing greater general coverage from the same flying height; accordingly, fewer photographs were required in order to cover a specified area. With less flying involved, costs of air operations were reduced and there was also greater freedom from distortion in the views produced. Burns, in fact, prophesied that if the new lens proved successful in field use it would replace the seven-lens camera then being tested in Canada for use in aerial photography.[11] This particular development is now regarded by some authorities in cartography as constituting the initial break-through in 20th century map making, leading to more economically produced and more accurate maps. Refinements in both plotting equipment and in aerial cameras followed the introduction of the multiplex aeroprojector. In 1935 Burns was awarded the Order of the British Empire for his valuable contributions to the progress of aerial surveying and mapping.

A second plotter was devised by Burns, incorporating features of an invention of Dr. Fourcade, a South African scientist. Fourcade had devised a new method of solving the problem of tilt in the taking of survey photographs from the air, thus permitting two overlapping pictures to be set in relative orientation.[12] This second plotter, intended for use in Canada, was constructed in the United Kingdom by Barr and Stroud of Glasgow. The cost of its production was borne by Imperial Oil Limited. In the summer of 1940, before the plotter could be shipped to this country, a German bomb struck the building in which the instrument was housed, completely demolishing the structure and its contents. There was no effort made to replace the equipment and by the war's end that model, in any case, would have become obsolete.

The 1st Field Survey Company was formed in 1936 at Ottawa as a unit in the establishment of the Royal Canadian Engineers and as part of the reorganized Canadian Militia. Its function was to provide authentic information, in map and other graphic forms, for use in field operations under battle conditions. Its full peacetime complement, assigned to surveying, drawing, lithographic, and photographic sections, was fixed at 64 all ranks. Specifically the unit's duties included the establishment of mapping control either by traversing or by triangulation methods; the making of detailed topographic surveys by use of the plane table and providing the artillery with accurate survey data. The application of aerial photographs was to have high priority in its activities. In effect the company was to operate as a mobile mapping unit, trained to supply a wide range of detailed cartographic information on short notice and under conditions of extreme stress. Its personnel was to be recruited, in the main, from government surveying and engineering branches, from universities, and from upper grades of high schools. Lieut.-Colonel Burns devoted much thought and effort to the tasks of organizing and training this unit. In early 1939 the company consisted of about 35 men with Dr. H. S. Bostock and Dominion land surveyor C. H. Taggart as officers.[13]

Lieut.-Colonel Burns left the Geographical Section in 1936. In the Second World War, after commanding various brigades and divisions of the Canadian Army overseas he rose to the command of the First Canadian Corps in Italy. With the restoration of peace in Europe Major-General Burns, as he had become, returned to Ottawa to serve as Director General of Rehabilitation and subsequently as Deputy Minister of the Department of Veterans Affairs. From 1956 to 1959 he commanded the history-making United Nations Emergency Force in the Middle East, following the Suez crisis. In 1958 he was promoted to the rank of Lieutenant-General.

During the Second World War the Geographical Section, General Staff, continued its normal work program within Canada as well as performing some tasks connected with military operations. Lieut.-Colonel J. E. Lyon who, as a major, had succeeded Burns in charge of the Section, was posted to the Directorate of Military Operations and Intelligence in the autumn of 1940. Subsequently Major R. A. V. Nicholson, M. F. Phelan and A. E. Attfield shared in the direction of Section affairs and all signed on behalf of the non-existent Staff Officer (Survey). The first two named of this triumvirate retired at the end of 1942. From that time until the end of the war Attfield functioned as Acting Superintendent in actual charge of the Section. Col. J. H. Jenkins, as Director of Military Operations and Planning, continued to oversee activities of the Geographical Section, holding weekly conferences with Attfield to decide upon points of mapping policy.

On the outbreak of the Second World War there were in Canada only two Non-Permanent Active Militia engineer survey units. These were the 1st Corps Field Survey

Company, based in Ottawa, and the 2nd Corps Field Survey Company, based in Toronto. There was also an artillery survey battery in Montreal. Between the two world wars survey responsibilities for flash spotting, sound ranging, and gun-position fixing had been allotted to the artillery. In time each of the two corps of the Canadian Army overseas came to include an artillery survey regiment. The 1st Survey Regiment, Royal Canadian Artillery, served with the First Corps in Italy. The 2nd Survey Regiment, Royal Canadian Artillery, took part in the campaign in North-West Europe. There was also an Artillery Survey Reinforcement Unit stationed at a training centre at Borden, Hampshire, commanded by Major Lorne Swannell, son of the Dominion land surveyor famous for his survey work in British Columbia.

Military surveying and mapping had played an important part in operations during the First World War. In view of the wide-ranging technological advances that had taken place between the two world wars it is not surprising that these types of activity played a much more vital role in the Second World War. The longer range aircraft, with advanced methods of navigation required reliable aeronautical charts in the planning and conduct of bombing and other attack missions. The detection of enemy aircraft by the use of radar required accurate locations for the radar antennae, and coastal defence guns, firing great distances, had to be accurately positioned. In addition to the foregoing the services of surveyors were required in the layout of airfields, the building of roads and in many other wartime construction tasks. A number were also engaged in air photo interpretation work where their special knowledge of ground and air photographs was used to develop information about enemy installations, troop movements, assessment of bomb damage and so forth.

The greatest concentration of surveyors was to be found within the artillery and engineers. Besides the regimental and battery surveyors in each artillery unit there were the two survey regiments of the Royal Canadian Artillery. Their survey support to the artillery of each Corps included flash spotting, range finding, extension of theatre grid into requested areas as well as detection of enemy gun positions by radar. The surveyors in the engineers were largely concentrated in field survey companies and, in addition, each engineer field unit had sufficient surveyors to perform the survey tasks associated with the miscellaneous construction tasks in which they became engaged.

The military portion of the Geographical Section, General Staff, namely, the Permanent Force Survey Detachment, Royal Canadian Engineers, was based in Ottawa. This detachment was organized as No. 1 Survey Section, Royal Canadian Engineers, and was placed on active service on March 1, 1942, under Lieut.-Colonel F. G. Bird.

Canada's mobilization plans in 1939 called for the departure overseas of only one survey unit. Accordingly the Ottawa-based 1st Corps Field Survey Company left for England in January, 1940, with 7 officers and 137 other ranks, under the command of Major W. J. Baird.[14] During its sojourn in England this company was posted to a variety of stations in that country while undergoing intensive training and development. In May, 1942, the unit was renamed the 1st Field Survey Company, Royal Canadian Engineers, and was greatly expanded. Its personnel included topographers, trigonometrical surveyors, stereoplotters, lithographers, draughtsmen, and printers. When Major Baird became ill the company was commanded, in turn, by Major J. W. Robinson, Major H. L. Meuser, Major W. K. MacDonald, and Major S. G. Gamble.

In May, 1943, the 1st Field Survey Company was disbanded in order to form the 2nd, 3rd, and 4th companies. The 2nd Field (Topographic) Survey Company was under

Major T. C. Keefer. The 3rd Field (Reproduction) Survey Company was under Major C. H. Smith and the 4th Field (Air) Survey Company was under Major L. G. S. Trorey. The 10th Air (Survey) Liaison Section, Royal Canadian Engineers, came into existence under Major G. S. Andrews, destined to become, after the war, Surveyor General and Director of Surveys of British Columbia. Major H. L. Meuser of the original Canadian field survey company became Colonel and Deputy Director of Surveys, First Canadian Army, in April, 1942.

In the latter part of July and in early August, 1944, the 2nd and 3rd Field Survey companies and No. 1 Army Field Survey Depot disembarked in France, the latter unit under the command of Capt. W. J. Gordon Wadsworth.* Survey formations suffered their first battle casualties on August 8 during Operation Totalize. Lieut.-Colonel MacDonald, as he had become, was wounded and Lieut. R. B. Logie and nine men of the 2nd Field Survey Company were killed while fourteen others were wounded working along the Caen-Falaise road. The loss of fifteen topographical surveyors, listed among these casualties, seriously handicapped the unit. On August 12, Major Samuel Gill Gamble who, in 1958, became Director of the Surveys and Mapping Branch, Ottawa, was promoted to Lieut.-Colonel and replaced Lieut.-Colonel MacDonald as Assistant Director of Survey, Headquarters, First Canadian Army.

Canadian military surveyors at this stage of the campaign in Europe were exceedingly active producing defence overprint maps and artillery-fire plans, which were in heavy demand, in addition to the reproduction of numerous topographic maps. The first mobile map-printing press used by Canadian servicemen in England had been a hand-fed Mann press, mounted in a trailer and hauled by a Matador truck. This arrangement was replaced late in 1940 by a Crabtree press, scaled down in size to fit into the space available in the vehicle and mounted in a 3-ton, 6-wheel Leyland Retriever truck. Under active service conditions the 3-ton vehicle proved to be too light to handle efficiently the truck's normal wartime load. By 1943 printing plant contents, including the miniature press, had been transferred to a 10-ton Foden diesel truck, also equipped with expanding sides. By using the heavier vehicle working space was increased to an area 20 by 14 feet. A separate truck, containing a Lister diesel generator, provided power necessary to the operation of the press.

Surveyors of the 2nd Field Survey Company provided the basic survey data or theatre grid, assisted artillery surveyors when the need arose and undertook numerous other field survey assignments, such as the accurate positioning of devices for locating launchers of enemy V2 missiles. From the time of landing in France map production was maintained at a high peak. During the heaviest week of the campaign the Canadian unit produced 304,000 maps for a total of 1,045,000 impressions. Following the production stage, depot units stored and distributed maps as needed to division headquarters or to higher formations. This remarkable total performance, accomplished under the most trying conditions, well justified the use of a slogan summarizing the role of the engineer survey in war, namely, "An army moves and fights on maps".

Aerial revision of maps was carried on continuously during this eventful period. After the decisive clash at Falaise the speedy Allied advance soon outran the area of map revision for tactical purposes. Nevertheless by mid-September the 3rd Field Survey Company reported that all demands upon it for map reproduction work had been met

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*Later, Director of Surveying, City of Toronto.

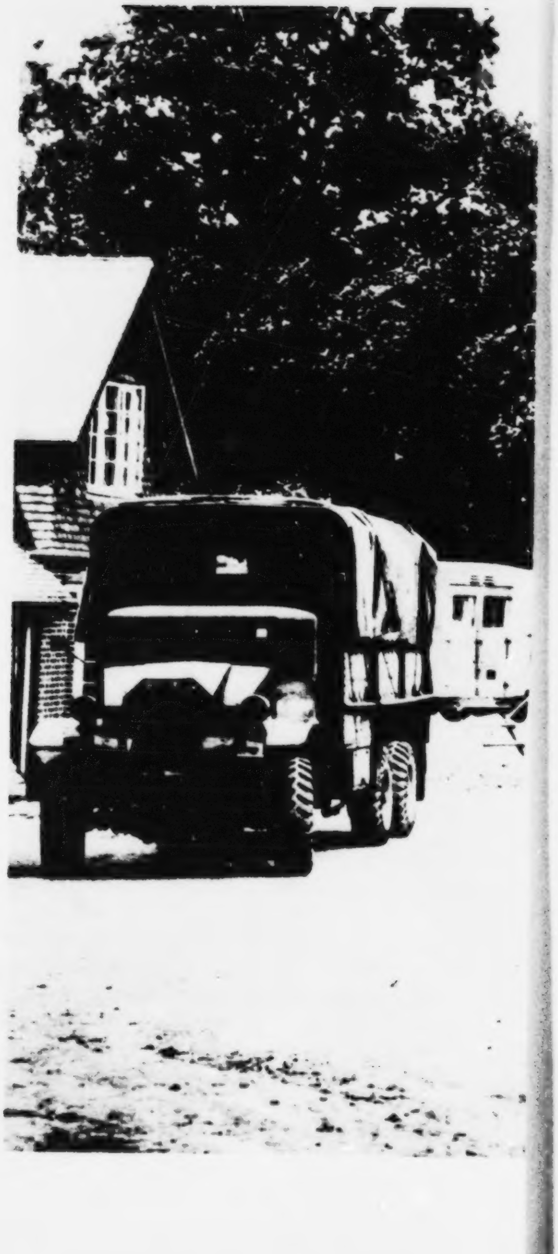


FIGURE 101
Two platoons of No. 3 (Map) Reproduction Company, equipped with Ford and Foden photo-mechanical and press trucks, somewhere in Surrey, England in 1944, preparing maps for the invasion of North West Europe.

on time and in the quantities needed. On September 5 the 4th Field Survey Company suffered its first casualties when Lieut. E. F. Klemmer, Sergeant W. E. Tose and Sapper G. Bell were killed. The 1st Map Photo Section of the 3rd Field Survey Company had been assigned permanently to the 4th because of the growing need for fast photographic action as well as for speed in the preparation and proving of plates.

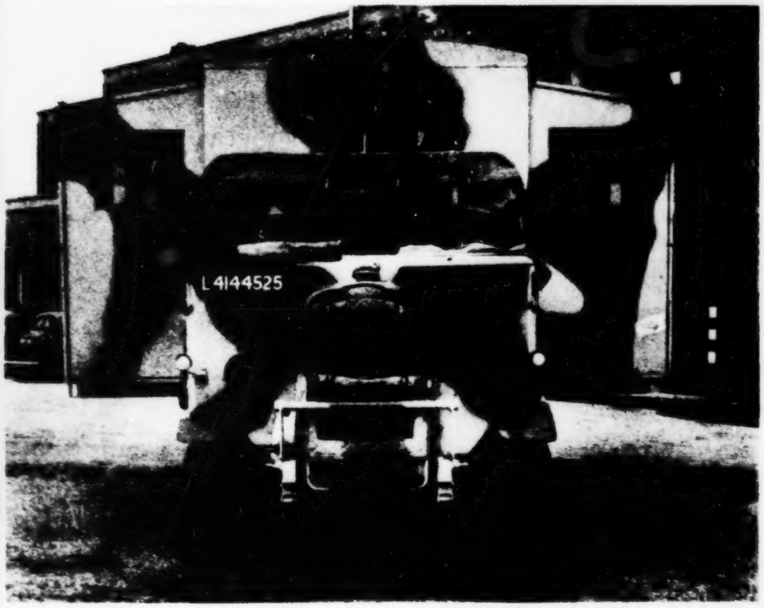


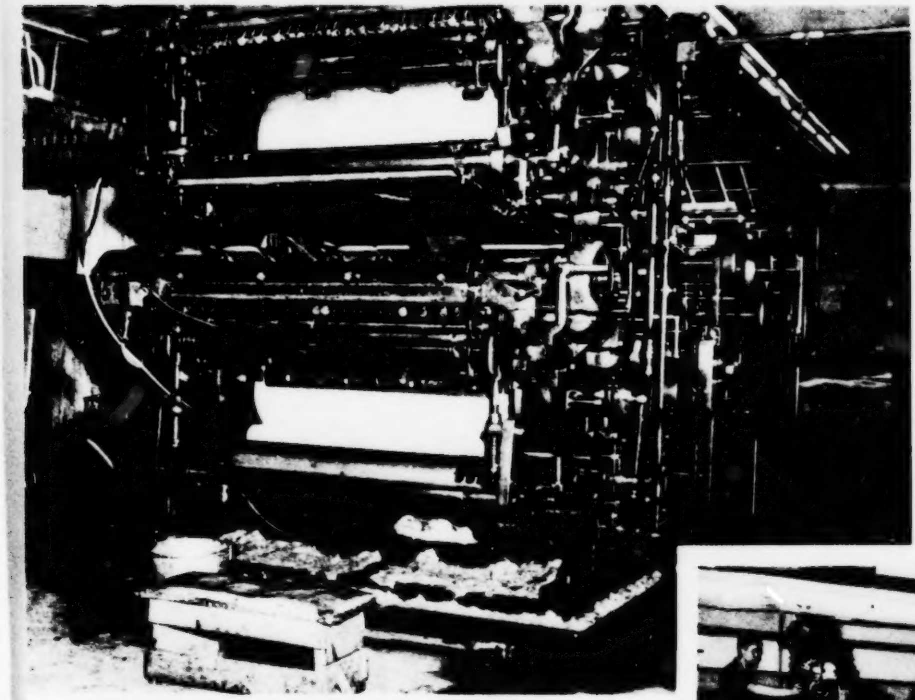
FIGURE 102
Leyland Retriever truck containing an army map press. Note extended sides to accommodate printing press.

By mid-November the Field Survey Depot had moved up to Tilburg, Holland, just before a flying bomb destroyed the building it had been occupying in Hoboken. Its stock of maps had been moved in 70 vehicle loads, a caravan forming marked contrast to the one lorry possessed by the original unit in England. At this time the Field Survey Depot carried some four million map sheets, representing more than 1,200 different maps.

On February 22, 1945, a Canadian map-printing detachment, specializing in the production of artillery-fire plans, moved into Germany. On March 12 it was followed by the 2nd Field Survey Company, ordered up in support of the 2nd Survey Regiment, Royal Canadian Artillery. After the Rhine crossing, topographers aided in the advance of Canadian troops into Germany and West Holland, conducting surveys of various bridge sites among other duties. On April 13 the 2nd Field Survey Company reached Meppen, Germany, and by May, 1945, the German surrender in North-West Europe had taken place.

The training and retraining of men for civilian surveying in Canada commenced at the location in Holland of the 2nd Field Survey Company in June, 1945. The unit had turned over its equipment to a Preliminary Dominion Land Surveyors' School, later renamed No. 2 Canadian Army Rehabilitation Training Centre (Survey). At least a score of candidates passed the examinations, supervised by Capt. A. I. Bereskin of the Royal Canadian Engineers who, after the war, became Controller of Surveys in the Province of Saskatchewan. Survey classes, however, came to an end before September 26 on which date the unit, with a complete change of staff, began to offer both general trade and academic classes at Zeist, Holland. This survey training program was curtailed by the unexpectedly rapid repatriation of troops to Canada.

On June 1, 1945, No. 1 Survey Section, Royal Canadian Engineers, serving with the Geographical Section, General Staff, became interim No. 1 Field Survey Company, Royal Canadian Engineers. The first officer to command this unit was Major (later Colonel) C. H. Smith who was also in charge of the Geographical Section. The company was re-designated and reorganized as the Army Survey Establishment, R.C.E., effective October 1, 1946.[15]



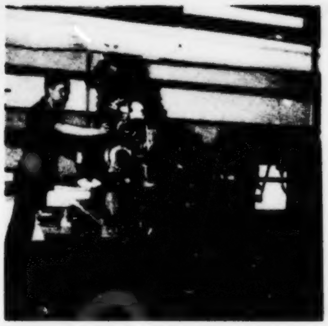


FIGURE 103
An Army Survey Establishment two-color Crabtree map press in Ottawa, 1940 to 1960. Right: Sgt. E. Besserer operating an A.T.F. Chief single-color map press, obtained by Army Survey Establishment in 1946.

The Geographical Section then ceased to exist although there followed a period of some months during which the Section continued to be mentioned as such in official correspondence. In reality, however, the civilian and other staff of the Section had been absorbed in the new Establishment which, within a short time, acquired its full complement of 14 officers, 189 other ranks, and 13 civil servants.

To faithfully record the story of surveyors and mappers in Canada's armed forces during the Second World War would require a full volume in itself. Because of the close relationship between civilian surveying and mapping in Canada and the activities of the engineer survey units in the United Kingdom and North-West Europe, and to a lesser extent of the artillery survey units, this all too brief résumé may serve, at least, as a guide to those who wish to delve more deeply into this significant chapter of Canadian military history.

One of the great military surveys in Canada, and one in which a Dominion land surveyor played a highly important part, involved reconnaissance and subsequent surveying in 1941 of Goose Bay airport in Labrador. The story of its discovery and rapid development is acquiring, with the passage of time, the peculiar sheen and durability of a legend.

The hazards resulting from German submarine activity during the Second World War made shipments of fighter and short-range bomber aircraft from Canada to Great Britain impracticable. As early as 1940 authorities in North America pondered over the problem of how such aircraft could be ferried, under their own power, across the North Atlantic in large and urgently-needed numbers. Long-range bombers were being flown to the United Kingdom from Gander airfield in northeastern Newfoundland but this station had become a traffic bottleneck and was of little assistance in providing facilities for a trans-Atlantic crossing by other types of warplanes. Discussions between Canada and the United States led to an undertaking by the government at Washington to investigate airfield-building possibilities in Greenland and Iceland. Canada agreed to reconnoitre Labrador for the same purpose. Such was the inter-government genesis of the Northeast Staging Route.

The coastline of Labrador was far from being adequately mapped at the time. Allied ship convoys bound across the North Atlantic to the British Isles were acutely conscious of the unrelenting menace of hostile submarines and enemy surface raiders. The Royal Canadian Air Force required a landing field of major proportions in Labrador and the Royal Canadian Navy needed charts of its coastal waters. On June 1, 1941, a Royal Canadian Air Force plane left Dartmouth, Nova Scotia, and headed for Labrador. Aboard this plane, on loan from the federal Topographical Survey Division, was Dominion land surveyor Eric Stanley Fry (1890-   ). On this assignment Fry and another Dominion land surveyor, Ralph William Clark (1907-   ) had been instructed "to obtain latitude and longitude fixes at points suitable for the control of mapping."

Fry, a tall, wiry, loose-jointed individual of 50 years of age, joined this historic venture through a strange combination of circumstances. Born on Dominion Day, 1890, in Sandbach, Cheshire, England, son of a Congregationalist minister, Fry experienced at 12 years of age a sunstroke of unusual severity. This illness resulted in his absence from classes for about six months and, not long afterwards, to an abrupt termination of his formal schooling. In 1917, when approaching his 27th birthday, young Fry came to South Edmonton (then Strathcona) in Alberta to join his older brother there.

Until 1910 Eric Fry worked at a number of occupations, mainly that of driving teams of horses for Grand Trunk Pacific Railway construction contractors. But on August 10, 1910, he began work with Dominion land surveyor Thomas Wood Brown who, at the time, was surveying townsites along the Grand Trunk Pacific right-of-way. For two months Fry served as an axeman, then "ran" an instrument. By the following season he had become a semi-qualified instrumentman, working on the townsites of Watrous, Melville, and Wainwright. In the field season of 1915, on Brown's recommendation, Fry served with Dominion land surveyor J. W. Pierce in the Athabasca region of Alberta. "I can't give you a job as assistant, as you are not a university graduate but come along with me as a chainman." This was Fry's first connection with the Department of the Interior and he was paid $70.00 per month for his services. F. W. "Weary" Beatty, later to become Surveyor General of Ontario, was a member of that same field party, surveying townships downriver from McMurray.

FIGURE 104. Honourable Wm. Benidickson (centre) with two veteran surveyors, K. G. Chipman (left) and Eric S. Fry (right).

Fry enlisted in the Canadian armed forces late in 1915. After serving on the Somme and at Vimy Ridge, injuries sustained in those actions brought about his hospitalization and final convalescence at Vancouver, British Columbia. On his release Fry returned to serve one season with Pierce in the field and then, on word from Ottawa, he reported to Dominion land surveyor Vicars at Kamloops. In the field seasons 1920 to 1923 inclusive, Fry was with Vicars, a man whose character and example influenced him to a greater extent than any other individual. In the following year Fry was awarded his Dominion Land Surveyor's commission, and shortly afterward began to take lessons in piloting planes. In 1926 he was asked to serve as a navigator on aerial surveys and to report to Winnipeg. Fry served in this capacity in various parts of Canada until 1938, a year when ambitious plans were being formed to conduct air surveys in Labrador.

Fry possessed a special feeling and fondness for the Canadian North. In part, perhaps, this preference may have arisen out of his need to protect himself at all times from the effects of strong sunlight, aftermath of the severe sunstroke he had suffered in his youth, and partly because he disliked crowds. He preferred the solitary life, far from the dullness of routine urban living.

So now, in the early summer of 1941, Fry was about to set forth on what was to constitute the most dramatic and significant survey experience of his career. The Stranraer flying boat, carrying the survey party, took off from Botwood, Newfoundland, on June 3rd and headed for Northwest River in Labrador. Sleet and icing conditions forced the plane back to its Botwood base. Venturing forth again the next day bad weather compelled a landing at Battle Harbour. After 12 days of enforced inaction, a sudden change of wind opened up a stretch of ice-free water and once again the party was airborne. Setting a compass course northwest by west they flew direct to the head of Lake Melville and to a landing near the settlement of Northwest River. Near here the mighty Hamilton (now the Churchill) River flows into Goose Bay, an arm of salt-water Lake Melville.

Fry was astonished at the difference in weather and temperature conditions existing between the two points, Battle Harbour and Northwest River. On the coast he had shivered amid ice floes and banks of clammy fog. Vegetation in the vicinity had been sparse. But at the head of Lake Melville, although still on tidewater, dense stands of timber extended down to the shoreline. Flower gardens bloomed and men moved about in straw hats and shirtsleeves.

It was decided that a ground investigation should begin at once of two possible sites for the required large airfield, sites that had been previously reported as promising. If it was then considered necessary a wider search of the region was to be made. Both of the suggested sites were found to be unsuitable under close scrutiny. Fry engaged Dan Michelin and a companion along with a power boat and stocked it with a week's provisions. His course was laid for the head of Goose Bay, where he visited John Groves, a man reputed to have an extensive knowledge of the surrounding country. It was while Fry chatted on the shore with Groves that he glanced westward across the inner Terrington Basin, beyond the narrows in Goose Bay, and was suddenly impressed by the profile of a distant elevated terrace silhouetted against the sunset.

Questioned about this geographical feature, Groves was less than enthusiastic over its possibilities as a site for an airfield. He cited the well-nigh impassable swamp existing between the ridge and tidewater. It appeared that Robert Michelin, brother of Fry's hired boatman, was the only white man known to have frequented the plateau. With Robert as guide Fry struggled along a footpath for some time and finally emerged, after a strenuous climb extending more than two miles, on an imposing terrace, flat as a billiard table and with perfect natural drainage, located about 120 feet above sea level. Two hours spent in examination of the plateau confirmed Fry's initial impression that the locality would meet all the requirements of a major airfield. The area, in fact, offered a veritable pattern of advantages; an airfield site on an elevated plateau, free of local ground fogs; the prospect of one-mile-long road across the coastal lowland; a sheltered, deep-sea ship harbor and seaplane site in nearby Terrington Basin. In addition, on closer inspection, the barrier swamp did not seem so impassable after all. Subsequent probes disclosed the existence of a natural ship channel in Terrington Basin of a width sufficient for all normal shipping needs and possessing an average depth of about four fathoms.

Without loss of time Fry prepared a preliminary report to Ottawa on his discovery. He strongly recommended the selection of the plateau and referred to it in his text as the "Hamilton River Site". This name, however, was destined to remain in the files at headquarters when officials there, perceiving the special fitness of "Goose" calling to "Gander" and vice versa, much preferred the appellation "Goose Bay Site".[16]

Fry's party, enlarged by local recruits, then proceeded to the plateau and began blocking off areas for future levels. A party was also formed to locate and mark out a road from Hamilton River at a point where barges, after being towed upstream, could be unloaded. Following this survey of block outlines, spirit levels were run around each block. A site for the main wharf was then selected and the location of a road from the wharf site to the plateau was surveyed. Rough soundings were made in the intervening swampy ground and the possibility of establishing a crossing of this obstacle by modern road-building methods and machinery was confirmed. Soundings were also taken throughout Terrington Basin and through the narrows to Goose Bay. These activities disclosed the existence of a natural channel of sufficient depth for serving the project by ships. Back at Northwest River plans and reports were drawn up and information compiled on which a final choice of site could be based.

During June, 1941, a United States exploratory party, headed by Capt. Elliott Roosevelt, son of President F. D. Roosevelt, undertook an aerial reconnaissance of Labrador for the same reasons that had inspired the Canadian search. The Americans also recommended to their headquarters in Washington, D.C. that the plateau site near Northwest River be selected but that advice was rejected at that time.

On July 14, 1941, Air Commodore (later Air Vice-Marshal) A. E. Godfrey, then stationed at Halifax, arrived with an engineer officer at Northwest River in a Catalina flying boat. Next day, with Fry, they examined the recommended site first by air, then on foot. Immediately following the subsequent quick flight to Ottawa of Air Commodore Godfrey the project was officially approved. In August advance parties of the Royal Canadian Air Force engineers flew in from Halifax to commence detailed surveys for the wharf, roads and runways. Soon a rough wharf was erected and within a short time thereafter the government ice-breaker *McLean* passed through the channel approach to dock at the new structure.

Contracts for construction work having been signed, other vessels arrived in mid-September, loaded with additional men, materials and machinery. These arrivals were forerunners of a small army of well-equipped workers, totalling more than 3,000 men. Three runways were rapidly levelled off and cleared to lengths of 7,000 feet each. Early in December the first landings of twin-engined bombers were successfully accomplished. A ski-plane had made the initial landing on the plateau one month earlier.

A depressing event in the early months of the Goose Bay airfield development was the loss at sea of two high-pressure boilers intended for the steam heating plant at the construction site. These boilers had been part of the cargo of a vessel sunk by enemy action en route to the project. With winter weather impending the prospects for providing suitable means of warming the living quarters appeared grim. The use of small local stoves seemed to offer the only practical alternative. But about 25 million feet of timber fuel would be required to maintain minimum comfort for personnel at the airfield until spring. To William Durrell, General Superintendent of the McNamara Construction Company, fell the task of locating needed wood-supply sources.

While reconnoitring in the bush, laboriously marking out areas containing stands of suitable timber, Durrell caught sight of what must have appeared to him at the moment as a mirage. Suddenly he had come upon two high-pressure steam locomotive boilers reposing in this northern wilderness, at least a thousand miles from the nearest railway. This sight was apparition enough but on closely checking the boilers Durrell found them to be freshly painted and completely rust free!

Durrell made his way back to camp with all possible speed. On his way he must have wondered whether the mysterious boilers would still be in existence when he returned to the place. The party that accompanied him on the return journey quickly confirmed the validity of his astonishing find. Later the whole story came to light. In 1907 a lumber company operating in the area had brought the boilers to the locality in order to provide power for their sawmill. The company began to experience financial troubles and its operations were suspended. The bank that had backed the venture with funds took title to the boilers as security for loans made to the ill-fated firm. There seemed to be little point in bringing the boilers out of the wilderness. Accordingly bank officials arranged to have a local Indian maintain the equipment in good working condition. True to his word the native looked after the boilers for more than three decades until their discovery by Durrell and subsequent installation as part of the heating unit of the airfield construction camp.[17]

Throughout the winter of 1941-42 construction continued apace and, by early summer, paving of the runways had commenced. On July 4, 1942, Eric Fry was on hand to witness the arrival at Goose Bay airfield of the first flight of fighter aircraft destined for points overseas, several score Lockheed "Lightnings". Two days later this air armada took off on a trail-blazing first-stage journey to the southern tip of Greenland. By early autumn, 1942, military aircraft of all types were passing through Goose Bay airfield in a steadily mounting stream. Early in 1943, for example, a group of 55 Flying Fortresses landed en route overseas. July 4 of that year proved to be the busiest day ever experienced at the airfield when 149 aircraft arrived and departed. In the 12-month period ended September 30, 1945, more than 24,000 planes had made use of this Labrador air station. With the advent of peace the Goose Bay and Gander stations continued as partners, rather than as rivals, to serve as major fields in the progress of aviation in general and in the growth of trans-Atlantic air traffic in particular.

In 1949, when Newfoundland entered Canadian Confederation, existing agreements between the Government of Newfoundland and the Royal Canadian Air Force became obsolete. The Royal Canadian Air Force was no longer "a lodger with a lease" on the Goose Bay airfield site. The changed situation also affected the legal position of the United States Air Force there and, in 1951, new inter-government agreements relating to occupancy were negotiated.

One of a number of abortive efforts made over the years to bring about an amalgamation of federal survey resources by combining the civilian and military survey organizations in Ottawa, took place early in 1947. A National Defence Department memorandum, drawn up on February 5 of that year by Lieut.-Colonel (later Brigadier) F. L. T. Clifford, indicated that evidence existing at that time was considered by the writer to be inadequate to justify the launching of official negotiations envisioning a merger of the Topographical Survey Division, Department of Mines and Resources, with the Army Survey Establishment. "We have at present a tidy little organization", Clifford stated, after investigating the possibilities of such a move, "whose war establishment should be filled up and on which the Army can rely." He pointed out that the Army Survey Establishment was then capable of producing 6,000 square miles of 1-mile-to-the-inch maps per year, a capacity that could be doubled when the organization was brought up to full strength. At the time also the Establishment was printing many maps on the 4-mile-to-the-inch scale, compiled by the Topographical Survey Division which, unlike the Army Survey Establishment, was not equipped to print its own maps. "Nevertheless", commented Clifford somewhat glumly, "it is inconceivable that Mines and Resources will ever allow its Topographical Survey Division . . . to leave their control. Consequently if there is to be any amalgamation it is most likely that the Army Survey Establishment would, in fact, become part of the Department of Mines and Resources." Military authorities in Ottawa, however, have continued to remain cool toward any suggestion of a merger under which their survey establishment would lose its identity in a predominantly civilian organization.[18]

Lieut.-Colonel John Richard Odlum Vicars (1855-1929), although not a military surveyor in the strict sense of the term, nevertheless deserves mention in this chapter as a highly competent Dominion land surveyor whose record of service in Canada's armed forces overseas was marked by special distinction. A number of land surveyors, including Eric Fry and H. L. Land, who served under Vicars during the course of various surveys in British Columbia, were indelibly impressed by the force of his character, innate dignity and outstanding integrity. He was invariably addressed or mentioned by these civilian subordinates as "Colonel" — seldom, if ever, as "Chief" (as is customary in survey parties) or any of those less exalted descriptions used by survey assistants in moments of extreme stress in the field.

Born in Ireland, Vicars was brought by his parents to Ontario at a very early age. At 31, after articling with Dominion land surveyor, W. T. Thompson, the apprentice was awarded his Dominion Land Surveyor's commission and began surveying in the western interior of Canada. He was also an Ontario land surveyor. But he spent most of his active career in British Columbia, including some years in the Railway Belt. In 1916 Vicars proceeded overseas in command of the 172nd Canadian Infantry Battalion. On demobilization he rejoined the Topographical Survey of Canada, Department of the Interior.

A six-footer of trim, sinewy build Vicars was regarded, even in advanced years, as equal in strength and endurance to many men half his age. Although he left most technical details of a survey project to his assistants he would always be "out on the line". Preferring the job of picketman above all other occupations in the field, he had an unerring faculty for locating transit station sites. When progress was being made smoothly Vicars would whistle or sing, somewhat unmelodiously, snatches of what came in time to be recognized by close associates as "It's a Long Way to Tipperary". He seldom was mistaken in his judgment of a man. As one of his assistants once expressed it, "when he focussed those piercing eyes on you, the pages of your mind just kept turning; he even read the footnotes . . . He stood out in a group of men in the same way that a Douglas fir dwarfs lesser pines; not by virtue of physical superiority alone but in the radiation of a personality that made itself felt in any environment."[19]

Vicars believed in permitting young surveyors to learn by hard experience. One day, for example, the axemen had left a small tree with branches that obscured the line of sight. Vicars sent the front chainman to cut the tree, warning him to be careful, although not giving any particular reason for the admonition. Explanations of his casual conduct were not long in forthcoming. The chainman, in carrying out orders, aroused a nest of hot-tempered hornets. The "oath of chainbearer" which resounded through the mountain glen was not that of the formal type set forth in Clause 95 of the Manual of Instructions to Surveyors.

Vicars was engaged in the field until the mid-1920s. Ottawa authorities then felt that he was too old for such strenuous activity. He was transferred, much against his wishes, to an office position in Calgary. Eric Fry tells of bidding him goodbye in that city in 1924. Five years later Lieut.-Colonel Vicars died in Kamloops in his beloved British Columbia at the age of 74. Shortly before the end he called for the bandmaster of the battalion he once commanded. "When you take me out to the cemetery", he requested, "you can play any kind of funeral march you please, but I want you to promise me that you'll play 'Tipperary' on the way back." His dying wish was respected and one of the bandsmen, much moved by the occasion, was heard to remark afterward, "That cold wind from the North Thompson sure can make one's eyes water."

An account of the role of military surveying and mapping in Canada, however brief, would be incomplete without a reference to the distinguished part played in these endeavors by Dominion land surveyor, Robert Douglas Davidson (1892-1960). Born in Newcastle, Ontario, Davidson studied astronomy and geodesy at the School of Practical Science, University of Toronto, graduating with honors in 1914. During the summer seasons of his student years Davidson worked with survey parties in the field in western Canada, an experience that led him to join the Topographical Surveys Branch of the Department of the Interior. His civilian career was soon interrupted, however, by enlistment in the Canadian Army. Davidson served as a gunner in France from 1916 to the end of the war. On returning to Canada he rejoined the Interior Department. "I recall", one of his colleagues of later years has recorded, "his mention of the fact that he disappeared into the bush in 1919 with a survey party and remained in the wilderness for almost 18 months in order to regain a truer perspective of life after the years of upheaval and conflict."[20]

In the post-war period when large-scale experiments in aerial photography for surveying and mapping began in Canada, the Royal Canadian Air Force assumed responsibility for the flying chores involved. The navigation of planes engaged in this type of work presented, at the time, a technical problem of considerable proportions. In 1924 Davidson, as has been noted earlier in this volume, was chosen to be one of the crew of four of the Vickers Viking flying boat, assigned to make the now famous pioneering photographic flight in the course of that survey season. This undertaking, lasting five weeks, covered areas featured by Pelican Narrows, Lac Ile-à-la-Crosse, Wollaston Lake and Lac Brochet. The name of the Viking's pilot, Squadron Leader Basil Hobbs, is perpetuated among those listed on the impressive Memorial at Wright Field, Dayton, Ohio, as one of the trail-blazers who contributed notably to the progress of aviation in the Americas.

Davidson's navigational feats during the early days of aerial surveying in Canada also became legendary. As work progressed and the need for navigators grew in this field of effort, Davidson was joined in the performance of these special tasks by Dominion land surveyors John Carroll, Frederick Hay Wrong, Cecil Donnelly, and Eric S. Fry. During the decade following the development of the Canadian perspective grid by Dominion land surveyor Robert B. McKay and associates, including Max

Cameron, airborne photographic crews traversed large, previously unmapped regions of northern Canada.

In 1932 Davidson joined the staff of the Geographical Section, General Staff, as technical advisor to Burns, at a time when the main emphasis was being transferred from oblique to vertical air photography. Davidson's unusual skills as a field topographer and as a practical photogrammetrist proved invaluable to the Section. He possessed a special ability to analyze any new method and to detect, with quick perception and insight, its main advantages and disadvantages. "Most of our work [in the 1930s]", Davidson once pointed out, "extended along the south border of the Dominion which is the most heavily settled district with much man-made detail to interpret. These conditions at once ruled out the oblique method [of aerial photography], so successfully used for maps of smaller scale in more sparsely-settled districts and, from the first, our attention was concentrated on vertical photographs, with obliques relegated to a minor role."[21]

After more than a half-century of service, initially in land surveying and, later, in aerial photography applied to surveying and mapping in Canada, Davidson retired from the Section. In 1959 he was the recipient of a special award given by the Canadian Kodak Company "for the most outstanding contribution to aerial photography" made during the years spanned by his illustrious career.

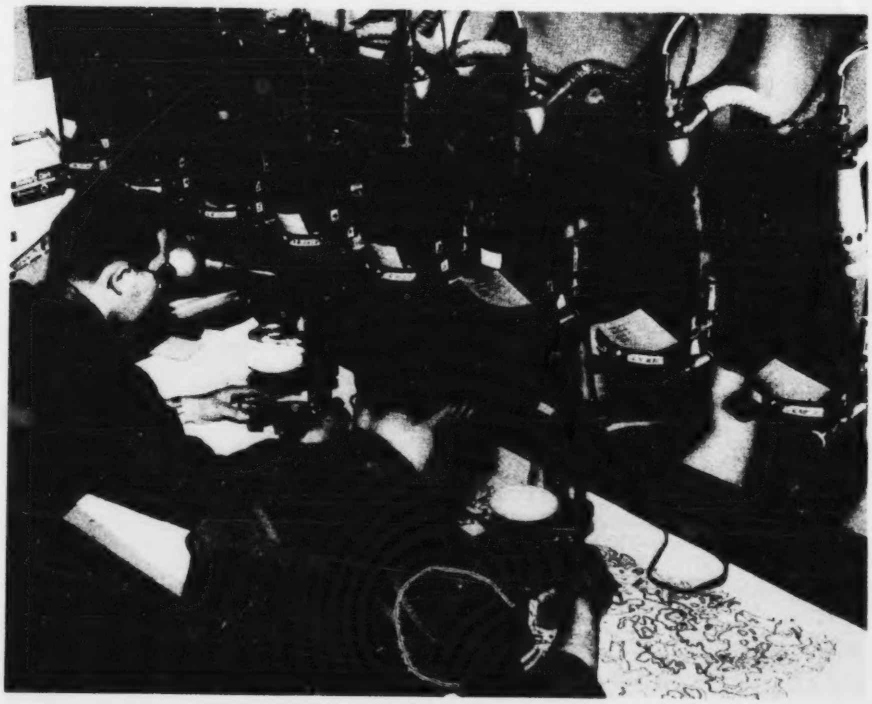


FIGURE 105. Army mappers using multiplex plotter for contouring.

As pointed out by Davidson in his 1946 address to the Canadian Institute of Surveying as its president at the time, one of the few redeeming by-products of war is the impetus given scientific research.[22] New developments in science, expedited by the exigencies of world conflict applied to destructive purposes, have been put to good use in times of peace. The professions of surveying and mapping, in particular, have benefited substantially from this phenomenon in human affairs. Out of the First World War the airborne survey camera emerged to become an important instrument of the surveyor and mapper engaged in promoting the peacetime development of Canada. Out of the Second World War came a number of practical applications of radar and of electronic instrumentation in these same fields and for the same constructive purposes. Increasing use was made of the newest photogrammetric equipment. Computers began to be employed in the reduction of field survey computations and in the resolution of the geometry of aerial photography. Scribing techniques replaced pen and ink draughting in map making. New developments in lithographic offset printing served to expedite map-reproduction work. Military mapping extended to all of Canada, interlocking with civilian operations conducted under the direction of the federal Surveys and Mapping Branch and by provincial government surveying and mapping agencies. The time was not far distant when the annual production of maps by the Army Survey Establishment would approach the total national output of all maps published in Canada prior to 1947.

11

TOWN PLANNING AND THE TORONTO SURVEYS

> "*But to the place,—it standeth north north-east by east from the west corner . . .*"
>
> —*Love's Labour's Lost*, Act 1, Sc. 1.

Town planning, as the term has been applied to Canadian conditions, has been defined as "the scientific and orderly disposition of lands and buildings in use and development with a view to obviating congestion and securing economic and social efficiency, health and well-being in urban and rural communities."[1]

The increasing concentration of Canadians living in urban centres during the 20th century resulted in greater emphasis being placed on the role of the surveyor in land subdivision work on the fast-spreading outskirts of the larger cities. Undivided acreage of this description becomes to the town planner what a canvas means to a painter — a canvas on which a mere daub, a fairly presentable picture, or a veritable masterpiece may appear. The subdivision of land, in more than one aspect, is the foundation of all subsequent town planning and no single factor has exerted more influence on the future of a city or its suburbs than the original layout.[2]

Before the advent of the professional town planner in Canada the land surveyor, in a limited sense, planned a town or city, and the municipal engineer constructed, maintained and operated the urban organism. This combination operated effectively in many communities in Canada's western interior. Accordingly the surveyor's work had an important bearing on that of the municipal engineer and the efforts of both exerted a significant influence on Canadian life and progress in urban centres in the first few decades of the 20th century. The practising land surveyor, because he was involved directly with the establishment of property boundaries, had continuous contact with both the landowner or developer of a subdivision as well as with municipal authorities. He was thus in a unique position to reconcile, wherever possible, their points of view. The surveyor and the engineer contrived together to create an environment which provided a city or town with form, if not with substance. Their decisions usually reflected the attitudes, traditions and dynamism of their times and had a profound impact upon the entire urban complex of Canada.[3]

Town planning in Canada, on a professional basis, began as early as 1914 when the federal Commission of Conservation appointed the Edinburgh-born land surveyor Thomas Adams (1871-1940) as its Town Planning Advisor. Adams, who had achieved prominence in England as a consultant in the planning field, had been induced to accept the Canadian post by a town planning enthusiast of Ottawa and Toronto, Noulan Cauchon. Adams felt strongly that land within township boundaries should not be settled

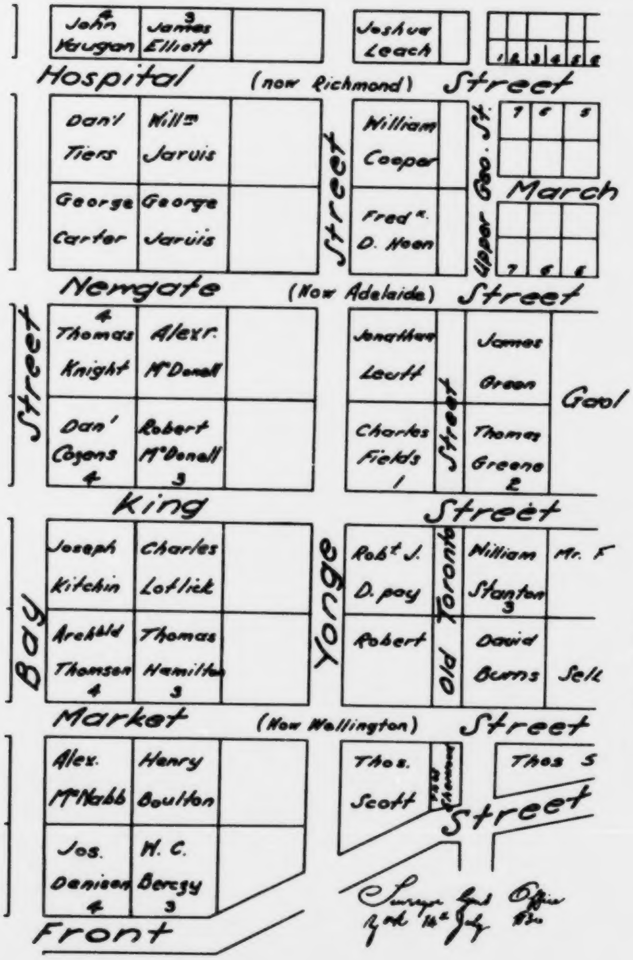

Hospital (now Richmond) Street
Newgate (Now Adelaide) Street
King Street
Market (Now Wellington) Street
Front
Bay Street
Yonge Street
Old Toronto Street
Upper Geo. St.
March
Gaol
John Vaugan
James Elliott
Joshua Leach
Dan'l Tiers
Willm Jarvis
George Carter
George Jarvis
William Cooper
Fredk. D. Hoen
Thomas Knight
Alexr. McDonell
Dan' Cozens
Robert McDonell
Jonathan Levitt
James Green
Charles Fields
Thomas Greene
Joseph Kitchin
Charles Loflick
Archibld Thomson
Thomas Hamilton
Robt. J. D. poy
Robert
William Stanton
David Burns
Mr. F
Sell
Alex. McNabb
Henry Boulton
Jos. Denison
H. C. Bercsy
Thos. Scott
Thos S
Street
Survey. Gnl. Office
York 14th July 1830

FIGURE 106
Sketch of downtown Toronto. Map from Office of Director of Surveys, City of Toronto (Town of York, July 14, 1830). Tracing by George Wood.

FIGURE 107. Toronto: Old and New.

upon until a proper plan of development covering the township as a whole could be prepared and then approved by a competent director of surveys acting in collaboration with a skilled director of planning located in each province.[4] Incidentally, by 1917 most of the provinces of Canada had town planning legislation on their statute books. Alberta, in 1913, was one of the first of the provinces of Canada to pass legislation of this nature. Some of these provincial acts were permissive, others mandatory.

A surveyor, according to Adams, should not only measure the land but should make a survey of its potentialities for beneficial use. In his opinion the rectangular form of survey should not have been the basis for settlement but should have provided only the foundation on which a proper development plan for each township could be prepared. Adams, in particular, criticized the rectangular system in its application to cities, claiming that this approach resulted in little better than "block plans for sites, planned gridiron fashion, to facilitate the operations of speculators in real estate." Adams regarded the land surveyor as more than a measurer of lines. He saw him as a human instrument by whom conditions under which people lived could be vastly improved.

Adams proved to be an energetic and able evangelist of town planning in this country and before long the Town Planning Institute of Canada came into existence on an informal basis. Not surprisingly Canadian surveyors, through the Association of Dominion Land Surveyors, played an influential part in bringing about the formation of this important agency. In 1918 the surveyors were joined by members of the Engineering Institute of Canada and of the Architectural Association of Canada to promote the creation of the Institute. This was a natural alliance for the purpose, involving as it did the abilities of all three professions.

Surveyor General Deville as well as D. H. Nelles became charter members of the new organization. In 1921, Deville, a vice-president, was named chairman of the editorial committee responsible for the contents of the Institute Journal. The main objective of the new Institute, formally incorporated in 1923, was to promote the scientific and artistic development of town and country on the basis of these joint contributions. The architect's concern would be in groupings of buildings and in the compositions of entire districts of a town or city rather than with the appearance and utility of any individual structure. The municipal engineer's function in planning would be to examine, in particular, the problems of transportation in the community. The surveyor, in Adams' view, ought to be interested in the best use of land, not just in the accurate measurement of it.[5]

During the mid-1920s a number of land surveyors provided important leadership in town planning activities in various parts of Canada. Horace Llewellyn Seymour (1882-1940), commissioned a Dominion land surveyor in Ottawa in 1906 and an Alberta land surveyor five years later, contributed an address, entitled *Town Planning and the Surveyor*, to the 1915 annual meeting of the Alberta Land Surveyors' Association. In that same year Seymour, who had also won surveyor's commissions in Quebec, Ontario and Saskatchewan, withdrew from the practice of surveying and entered upon a career in town planning. Ten years later Seymour drew the special attention of surveyors to the far-sighted town planning projects being launched at that time in Waterloo County, Ontario, and in the city of Kitchener. In the latter community zoning by-laws determined the height, set-back and area of occupancy of buildings but no authority existed to exercise control over construction just beyond the limits of the city. Steps were being taken, even then, to obtain the cooperation of the nearby town of Waterloo in the preparation of zoning by-laws there that would match those of Kitchener.[6]

Seymour was one of the first Canadians to emphasize the indispensability of mapping to effective town planning. In the Waterloo experiment a part of the township had been mapped and contours shown. Thomas Adams, in his report on the planning of Kitchener, also declared that it would be of immense service to the city and township authorities if a map of the whole county could be produced on a scale of 2,000 feet to the inch, showing topographical features, railways, highways and some of the most important levels. Seymour, a president of the Town Planning Institute of Canada, advocated that Waterloo township demand the production of an improved thematic map of the county.

Dominion land surveyor Joseph Edwin Underwood, who was also a Saskatchewan land surveyor, took a keen interest in town planning from the time of its earliest applications in Canada and was, in fact, elected an alderman in Saskatoon in 1927 on a platform advocating the adoption of such planning procedures in that community. Another member of both those organizations of land surveyors, Stewart Young of Regina, became Director of Community Planning for the province of Saskatchewan in 1924. A distinguished graduate of the School of Practical Science, then affiliated with the University of Toronto, Young began his career as a surveyor in 1912 when he was assigned by Surveyor General Deville to a survey party operating in British Columbia under M. P. Bridgland. Young, in common with Adams and Seymour, stressed at all times the importance of mapping to town planning. He firmly believed that the rights of individual property owners as well as the interests of the community as a whole would be well guarded by the appointment of trained engineers to a permanent town planning board.[7]

The views of Stewart Young in this field helped bring about the passage of an improved Saskatchewan Town Planning Act in 1928, a measure that replaced the Town

FIGURE 108. Horace L. Seymour.

FIGURE 109. Stewart Young.

Planning and Rural Development measure passed in that province eleven years earlier. Other prominent Dominion land surveyors who took an active interest in town planning during this formative period were J. E. Umbach, C. H. Taggart, J. W. Pierce, and Carl Engler.

As early as 1919 the Association of Dominion Land Surveyors had established a committee on town planning under the chairmanship of Seymour. Its other members were J. D. Craig, W. H. Norrish and E. J. Wight. This body decided that the subject was important enough to bring before the Association executive.[8] The committee's report was submitted to the annual meeting of the organization in 1920 by Albert Howard Hawkins, who also served at the time as secretary of the Town Planning Institute of Canada. The report stressed the usefulness of maps in any intelligent planning of future urban development, with special reference to population distribution, placement of buildings, lines of transportation, public utilities, schools and parks as well as in relation to taxation and assessment patterns.[9]

In 1921 the Geodetic Survey of Canada published a study by Dominion land surveyor Douglas Henry Nelles, a publication that won wide interest in the United States as well as in Canada. The author was fulsome in his tribute to the part played by mapping in town planning generally. "An accurate topographical map", he wrote, "helps to solve all the fundamental problems in the life of a community which arise in trying to establish a higher standard in the health, education and happiness of the people. It is a basic element in all scientific town planning. It is the Bible of the working departments of the municipal governments." Nelles also pointed out that in addition to their functions in relation to various engineering projects within a community, maps were essential in classifying land for residential, commercial, or industrial purposes, for assessment work and in the planning of local improvements. "No town planning scheme", the author asserted, "or engineering work of any size can be carried out efficiently without the aid of topographical maps. A large-scale topographical map of a city and the country in its vicinity shows the conditions . . . at the time of the survey, the relation between the natural and artificial features expressed in distances and elevations, from which much can be calculated . . . The general accuracy of the map will ultimately depend on the accuracy of the framework which . . . will consist of primary points fixed by primary or secondary triangulation."[10]

In 1924, the year of Deville's death, editorial comment in *The Canadian Surveyor* supported the creation in Ottawa of a post-graduate school of town planning to serve, in part, to educate practising surveyors in the principles of urban and rural planning. "Modern development of town planning", the editor declared, "which has evolved from the necessities of solving the slum problem and which brought to our understanding the relations which street widths and heights of buildings bear to the access of light and air . . . is the great sociological achievement of the age. The surveyor has, in the nature of things . . . much influence upon subdividing and a heavy moral responsibility in the ultimate sociological results of his planning . . . The future of surveying would seem to hold great opportunities in replanning for the better disposition of people upon rural land no less than for adjusting them within city limits."[11]

The 1927 report of the committee cited some noteworthy examples of town planning then under way in Canada. Mention was made of the development along planned lines of university endowment lands in the Point Grey district of Vancouver. A zoning scheme for Canada's capital, prepared by its Town Planning Commission, was under consideration at the time by Ottawa's city council. A land-use map was being prepared in Victoria, British Columbia, in anticipation of the passage of a zoning ordinance in that city. The Aluminum Company of Canada had undertaken extensive town planning work in preparing the layout of the community at Arvida, Quebec, designed to accommodate company employees. Kitchener, as already mentioned, was ahead of most large Canadian urban centres in the adoption of planning procedures. It was noted in the report, in conclusion, that in those parts of Europe and the United States where town planning had made the greatest headway, it had expanded into regional planning.[12]

The committee's 1928 report posed a perceptive question — "Cannot the resources of science, so effectively employed for purposes of wartime destruction, be devoted in times of peace to the building of more interesting, orderly, efficient and beautiful towns and cities?"[13] The abolition of the federal town planning office, established in 1914, was noted with regret. In the general discussion following the report, mention was made for the first time of the possibility of employing aerial photography as an aid in effective town planning. Application for two memberships in the Town Planning Institute, which had continued to function effectively, was made at this time by the Association of Dominion Land Surveyors.

The evolution of Toronto from its beginnings provides an example typical, in certain salient respects, of the development of town planning in Canada. Even before the arrival in this country of John Graves Simcoe, the Governor in Chief, Lord Dorchester, had taken steps to prepare for the building of a town on the site of Toronto. In 1788 Deputy Surveyor Alexander Aitkin had been instructed to lay out such a townsite. His plan placed the proposed settlement, in the main, in the area now bounded by Spadina Avenue and Toronto Street and extending northward from the waterfront almost to Gerrard Street. The town was to be surrounded by a commons about a half-mile in width and by a belt of government reserve land beyond. Subsequent pre-Simcoe planning for this townsite was based on the initial Aitkin pattern but the site was enlarged to a mile and a quarter square.[14]

In 1788 also Capt. Gother Mann of the Royal Engineers drew up a town plan for a settlement on the site of present-day Toronto. This plan was based on both Aitkin's design and a map of Toronto Harbour made by John Collins earlier in the year. Deputy Surveyor General Collins of the province of Quebec had been authorized by Lord Dorchester to investigate and submit a report to him on military posts along the Great Lakes. Mann's plan, accompanying that report, represented an area of one square mile, divided into 121 lots.[15] Six lots were set apart for use as public squares or for the erection of public buildings. Bordering a central common were township lots described as town parks. These early plans reflected the thinking of that period concerning layout of towns in newly-opened territories and placed the townsite some distance east of the Humber River and close to the route of the Toronto Passage. This route followed river valleys leading northward from Lake Ontario and offering the shortest approach to the Upper Lakes.

Two years later, in 1790, Deputy Surveyor Philip Frey received instructions from Quebec to lay out the front line of a range of eleven townships, extending from the mouth of the Trent River westerly to a mile or so beyond Toronto Harbour. The most westerly of these townships was named Dublin. As Frey happened to be occupied elsewhere these instructions had to be renewed in the following year, Deputy Surveyor Adolphus Jones being entrusted with the township survey task. The instructions to Jones involved only the measurement and marking of a single line across the front of each township. His line across Scarborough Township, named Glasgow at that time, ended about three and a half miles north of Lake Ontario. Before pressing on, Jones ran the boundary between Glasgow and Dublin townships south to the lake, then continued across Dublin Township on the line of present-day Queen Street, Toronto. The system of subdivision was that which is found even today in Scarborough and townships farther east, namely, lots 20 chains wide by 100 chains deep, with a side road every other lot and each township 35 lots, or about 9 miles wide.[16] Within a few years the name Dublin Township vanished from official use, to be replaced by Toronto Township. Before Jones had measured off 35 lots along what is now Queen Street he reached Lake Ontario at present-day Sunnyside and had to offset his line to the north to complete the survey of the entire township boundary. The western boundary of Dublin Township, as established by him, was not far from the centre of today's High Park.

About this time certain surveys were being made of Toronto's harbor. In 1792 the commander of British naval forces on the Great Lakes requested data on the depth of water in the harbor and it is likely that Plan 14 in the Surveys Branch, Government of Ontario, the work of Adolphus Jones and entitled "Plan of the Front Line of Dublin with the Harbour and Soundings" was the result of that request. A more detailed survey of the harbor was made either late in 1792 or early 1793 by Joseph Bouchette. During 1793, after the town of York survey plan had been completed, Alexander Aitkin was ordered by Simcoe to make another survey of the harbor. His plan was, in fact, quite detailed, showing lagoons at Toronto Island, creeks on the mainland, harbor soundings and the sites of the town and the garrison.[17] Not until 1818 did another survey of the harbor take place, when Lieut. H. W. Bayfield, R.N., performed the task for the British Admiralty.

But Toronto as a community of importance began its career in 1793. It was in the summer of that year that Lieut.-Governor Simcoe sailed from Niagara-on-the-Lake to Toronto Bay and set up temporary headquarters on its shore. He was accompanied by deputy surveyors Aitkin and Jones as well as by men of the Queen's Rangers and some artisans. The soldiers and skilled workmen not only erected a fort but also, within a few years, built homes, mills, wharves and warehouses. On June 26, 1793, instructions were given to Aitkin and Jones "to survey the southerly part of the Township of York" and to lay out a small townsite on the north shore of the bay.

Apparently Aitkin was mainly responsible for laying out the townsite as the diary kept by Jones indicates that the latter was occupied during most of the field season in surveying concession and side roads in York. From the harbor plan produced by Aitkin it is known that the original plan of the town of York consisted of 10 blocks, each containing lots 66 feet in width by 132 feet in depth. The town plot was in the form of a parallelogram, bounded on the north by Duchess (now north Adelaide) Street, on the south by Front Street (East), on the east by Ontario Street and on the west by George Street.[18]

A scramble to obtain town lots took place among prospective settlers in early September, 1793, but there was a definite effort made by the authorities to discourage real estate speculators. Lots of 100 acres in size were allotted to members of Simcoe's official and personal entourage. Most of the new owners cleared the lots for farming purposes. As for the smaller lots of the townsite the total of 80 seemed, in comparison with the recently surveyed towns of Kingston and Newark, quite modest. For Simcoe's purposes, however, the establishment of a garrison was the prime consideration. Completion of the townsite survey task marked the beginnings, then, of the "old town of York" as it came to be called. The original fort and other structures of those early times have long since vanished from the scene but the posts planted by the surveyors remain the foundation of property ownership based on that ancient townsite.

Zoning regulations appeared in the earliest years of the new settlement at York, a fact borne out by a letter written by Hon. Richard Cartwright to a friend in which he states "You will smile perhaps when I tell you that even at York a town lot is to be granted in the front street only on condition that you shall build a house of not less than 47 feet front, two storeys high, and after a certain order of architecture . . ."[19]

It was Simcoe's idea that a military road should be built running due north to Lake Simcoe and designed primarily to carry trade to the North West. Out of this conception Yonge Street evolved. This highway was surveyed by Jones, assisted by John Stegman, during the field seasons of 1794 to 1796 and it developed into a key transportation artery that profoundly affected the long-term growth of Toronto. This road replaced the old trail bordering the Humber River and by-passed the site selected in 1788.

Poorly drained clay soils, responsible for the appellation "Muddy York" as well as malaria-infested swamps mitigated against the selection of such a site for settlement and prompted Col. Thomas Talbot to refer to the area as being "better calculated for a frog pond, or beaver meadow, than for the residence of human beings."[20]

What, then, were the principal factors leading to the choice made by Simcoe in 1793? Along the north shore of Lake Ontario there were other well-sheltered harbors, some of which commanded large streams leading even farther inland than those draining into the bay at Toronto. But Simcoe, judging from his letters, concluded that what is now central Toronto's waterfront constituted the best harbor on the Canadian side of the lake and described the location as a "natural arsenal of Lake Ontario, affording easy access overland to Lake Huron".[21] Collins, too, described the harbor as "safe, commodious and well-sheltered".

Simcoe's plan to link defensive advantages with commercial possibilities came to a natural focus at the site he selected. The fact that it provided entrance to a good route overland to the Upper Lakes, through the Toronto Passage, proved to be a determining factor in the making of this choice. In fact it was only after his examination of the Passage during the summer of 1793, which disclosed to him the excellent harbor on Georgian Bay at the northern terminus of the Passage, that the firm decision was made to build at what is now Toronto.

The founding of York was a bold move. The nearest white settlements, at the time, were Niagara and Kingston. In those early days York seemed to be "off the beaten track" in the existing pattern of communications. Despite the fact that, later on, the main trading route to the North West side-tracked the new town, its emergence as capital of Upper Canada made the site a focus for a number of roads in that strategic region. The location, in turn, enabled the settlement to become a leading centre for distribution of goods and services. The growth of the town was also stimulated, in the passage of time, by its proximity to a part of Canada rich in agricultural possibilities. But when the community first emerged, farming in the areas tributary to it was still in its infancy.

The shape and pattern of development of early Toronto were predominantly determined by government policies and planning. The old town of York, for instance, was a compact settlement, planned in its entirety by the authorities. Because the properties on the site were government-owned, expansion of the community was carefully organized as a unit and sensibly integrated with the original layout. The "new town of York" was laid out in 1797 in the area now bounded on the north by Queen Street and extending between present-day Yonge and Peter streets. The plan made provision for several large squares and the blocks of lots were generally of larger dimensions than those of the old town. But the blocks were not uniform in size. An 1850 map shows lots 150 feet deep along the east side of the school square. The church square was reduced by the grant of two acres to private individuals. This piecemeal system of land disposal accounts for the irregular street pattern that exists to this day between Yonge and Jarvis streets, south of Queen Street.[22]

In preparing York for the seat of government of Upper Canada, Simcoe made preparations to have additional lots surveyed and added to the townsite. Before his plan could be implemented Simcoe had to leave the province because of ill health. Peter Russell (1733-1808) was at that time President of the Executive Council and acting Administrator of the province. He had come to America from England in 1776 as an assistant to the British general, Sir Henry Clinton, during the Revolutionary War. Incidentally, Major Samuel Holland, Surveyor General of Quebec, had been attached also to Sir Henry's staff at that time.

In 1796 Russell instructed William Chewitt, the surveyor, to make surveys for an extension of the town westward on government-owned land. However, he experienced difficulty in locating lines of the original town plot. Indications of the problem he faced are found in the text of a public notice posted by Acting Surveyor General D. W. Smith on the order of Peter Russell, dated November 8, 1796. "No person is to presume in future", the notice proclaimed, "to lay down a House of Frame on any Lot in the Town of York until the surveyor who may be stationed there examines the spot and declares it agreeable to the Regulations of Council. Whoever shall attempt to move or to throw down any Boundary will be prosecuted with as much vigor as the Law permits — and if any person throws down a Boundary by accident in clearing his lot, he is to make immediate application to the surveyor's office there to have it fixed in its proper place; paying all reasonable expenses."[23]

In retrospect one consequence of these early Toronto surveys remains particularly impressive — the permanence of road and street lines laid out by the pioneer surveyors. Churches, houses, mills and taverns of the 18th century have vanished; gullies, streams and swamplands have disappeared; the shore has advanced into the bay by hundreds of yards with the reclamation of land from the lake. Yet, almost without exception, the streets of York laid out by Aitkin and Jones carry the traffic of today and the street lines defined by successors of those early measurers are nearly identical to the lines fixed on the heavily-wooded shores of Toronto Bay in Governor Simcoe's day. On incorporation of the City of Toronto in 1834 the name York was dropped.

One of the most interesting features of early Toronto surveys is the Windmill Line, first established in 1833 along the waterfront. This governing line is mentioned in many of the property deeds signed by William Chewitt and was usually described in such documents as a line produced "from the point near the site of the late French Fort west of Toronto Garrison to Gooderham's Windmill." The old French fort mentioned was Fort Rouille, destroyed in 1759. Within less than another century the Gooderham structure had been demolished. But for many years this line formed the southern boundary of all wharf structures and water lots. The windmill, built about 1832, seems to have been a very prominent feature of the east end of the harbor and stood near what is now Trinity Street. In 1893, by Order in Council the Windmill Line was extended 644 feet between York and Princess streets.[24]

Not all Ontario surveyors of the late 19th century were convinced of the authenticity of the Windmill Line. Alexander Niven remarked in 1887 that he had heard a Chief Justice interrupt a surveyor who was giving evidence in court and who had offered the opinion that "no one can say where the Windmill Line was located". The Chief Justice, to Niven's admitted surprise, declared that the Windmill Line was as well known as King Street. "I studied in Toronto", commented Niven, "and claim to know that the so-called Windmill Line was almost a myth. It existed theoretically but practically I believe no surveyor could define it!"[25]

Despite Niven's misgivings the City of Toronto in 1893 employed Ontario land surveyor Charles Unwin to retrace the Windmill Line. He ran the line through to Spadina Avenue on the ice. A plan in the office of the Director of Surveys, City Hall, Toronto, shows the line in relation to the then existing wharves and docks. When resurveyed in 1913, by Ontario land surveyor Norman D. Wilson, the Windmill Line had become the centre of the city's waterfront commercial life, cutting through buildings, docksheds and warehouses.

In the beginning of settlement of Toronto's core area the land extending north to Bloor Street between Parliament Street and the Don River was a government reserve and came to be known as The Park. When a piecemeal subdivision of this area began to take place south of Queen Street, then north of it, many small houses were crowded into the blocks, especially in what came to be known as Cabbage Town. This was an area, not marked by that name on maps or official surveys, in which English and Irish immigrants had settled in the period of cobblestone streets and gaslit shops. A century

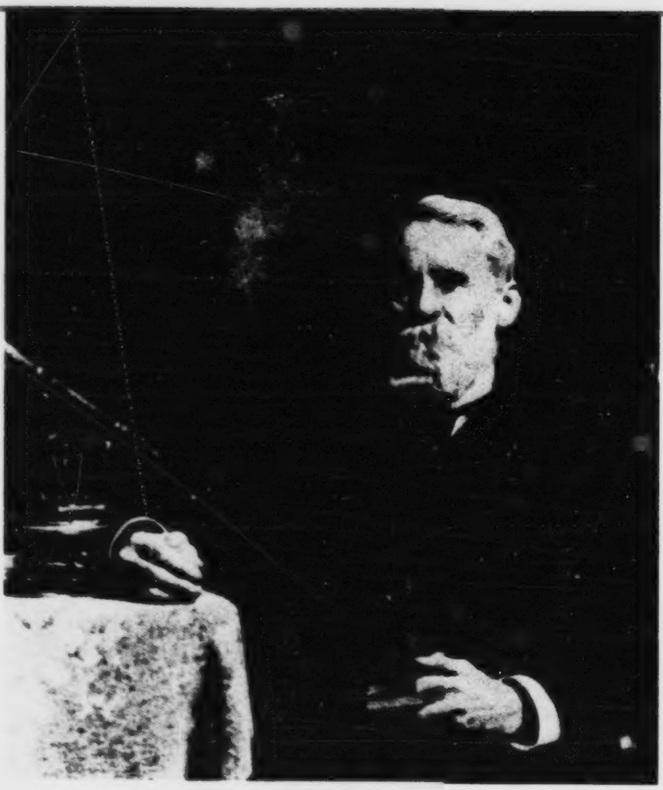


FIGURE 110
Charles Unwin.

later the Toronto newspaper columnist, J. V. McAree, son of a pioneer Dominion topographical surveyor, John McAree, wrote a book entitled *Cabbage Town Store*, published by The Ryerson Press in 1953 and in which life in that district of the early city was vividly described.

The advent of railways in the 19th century, with a number of lines radiating from Toronto, contributed substantially to its progress as a community. Investment of large sums in railway construction created new and expanding industrial activity and by 1851 Toronto's population had risen to 30,000. By that time residential expansion north of Queen Street had become necessary. Properties near Yonge Street developed first of all, a tendency that became more pronounced during the steady growth northward in the second half of the 19th century. For the most part, streets were projected on a north-south alignment along 100-acre lots. East-west connections remained poorly integrated. As early as 1853 locomotives were being built in the city. When a Toronto company built sections of the Grand Trunk Railway, enough capital was accumulated to enable Gzowski and MacPherson to establish, in 1860, the Toronto Rolling Mills. In addition to attracting line-building and line-maintenance workers to the expanding community, railway companies stimulated the establishment of machine and metal-making industries. By 1881 the city's population had climbed to about 85,000.

In southern Ontario the typical farm unit had been laid out in the form of a rectangle, its orientation being dependent upon the direction of the base line of the original survey. When such a farm was taken over for urban development the street system imposed upon it was generally prescribed by the rectangular grid. Any lack of uniformity in existing street patterns in Toronto reflects differences in the primary survey systems.

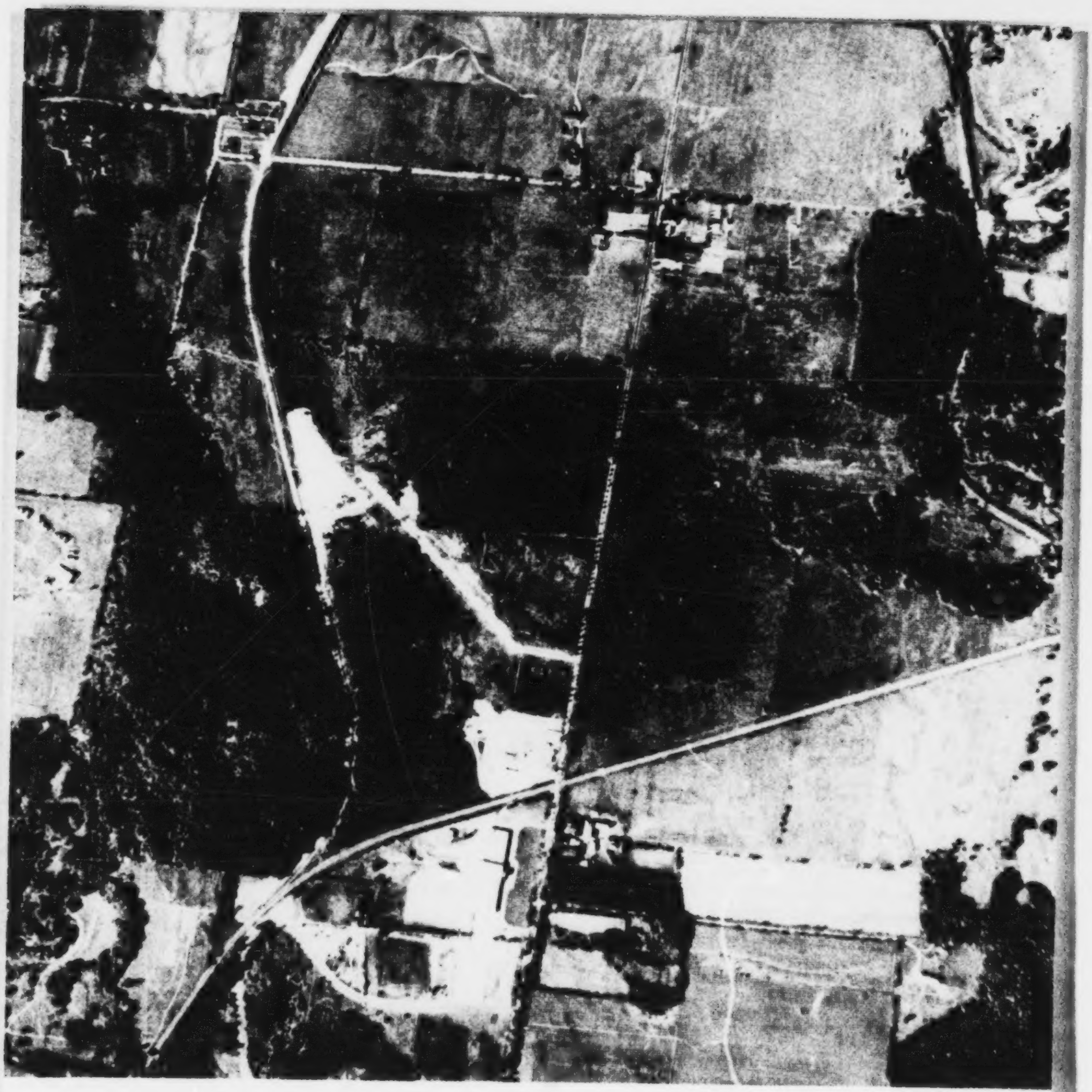
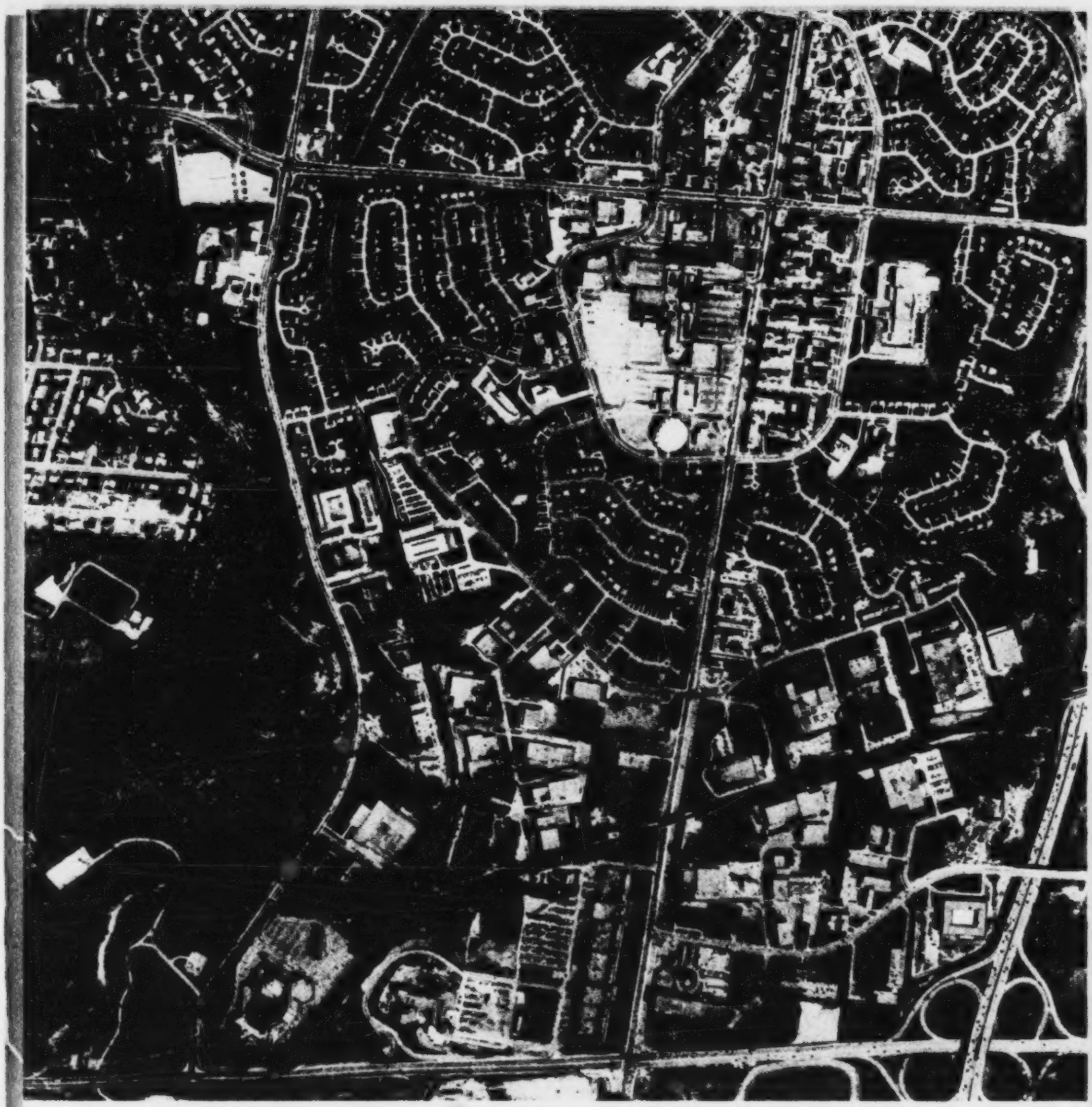


FIGURE 111. Urban developme

West of Yonge Street, between Bloor and Eglinton arteries and as far west as Keele Street, the dominant orientation of streets is a slight deviation from due north-south (N. 16°W. and N. 74°E.). West of Yonge and north of Eglinton as well as east of Yonge Street, north of Rosedale, the trend of thoroughfares is generally east-west. In short, these street patterns testify to the process of farm-by-farm expansion that has featured Toronto's growth to this day. An unhappy result of this process is the considerable number of jogs found in many of the city's thoroughfares. Most such discontinuities originate in the piecemeal subdivision of farms. Other jogs, especially those occurring in main traffic arteries, arose out of inaccurate surveys. In some cases elimination of these jogs, in order to facilitate the flow of increasing traffic, has been costly.



Don Mills, Ontario: 1952 and 1967.

At the turn of the century Toronto, unlike its pioneer nucleus York, was a community built without any over-all planning and with a minimum of government direction or interference. Its appearance, on the whole, reflected the almost random nature of its land-subdivision activities. By the mid-20th century, after several false starts, town planning had been definitely accepted as an instrument of enlightened administrative policy. Its application came not a moment too soon. During the 16 years following the end of the Second World War more land had been developed for urban uses in the Toronto metropolitan area than during the entire history of the city up to that time.[26] The phenomenally increased use of the automobile served to alter the face of most large cities of the continent. The increased mobility that resulted made possible, if it did not actually dictate, the mushroom-like growth of suburbs and of satellite communities not only in the Toronto area but in most important urban centres of Canada, the United States and Mexico.

During the First World War and most of the 1920s town planning as a tool of civic government continued to lie largely unused. From 1912 to 1930 all such planning within urban Toronto was entrusted to the City Surveyor's office, a branch of the municipal assessment department. By 1929, however, an Advisory City Planning Commission had come into existence. During the 1930s, following rejection by public ballotting of suggestions proffered by the Commission, town planning activity receded. At the beginning of that decade the City Surveyor's office was expanded and became the Department of City Planning and Surveying, continuing as such until 1954. But the planning work of the Department consisted mainly of approvals and layouts of subdivisions, planning of streets and traffic engineering generally, together with the establishment of all legal surveys for the municipality.

Not until early in the Second World War, when post-war reconstruction and expansion were under consideration, were demands for town planning measures vigorously reviewed. On June 1, 1942, the Toronto City Planning Board was established and all planning submissions came under the purview of the City Surveyor, for presentation to the Board. Although this body was advisory only in function, its recommendations had very far-reaching effects upon the development of post-war Toronto. Its report, in fact, was the first comprehensive proposal for town planning for the metropolitan area, from greenbelts and a civic centre to land-use maps within the city proper and the establishment of zoning standards. In 1947 the City of Toronto and 12 suburban communities,

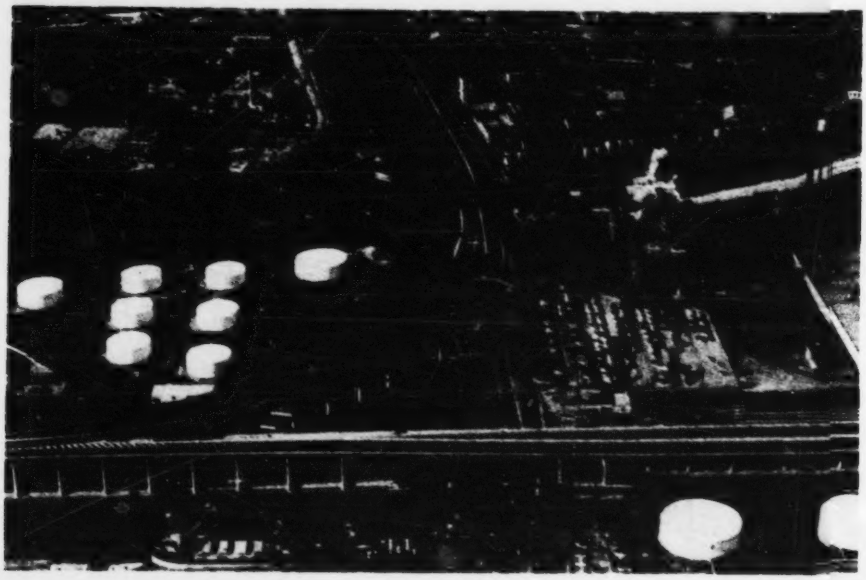


FIGURE 112. Mouth of Don River, Toronto.

totalling 250 square miles, developed and undeveloped, containing more than one million inhabitants, were formed into a planning area under the jurisdiction of the Toronto and Suburban Planning Board. This forward step was taken under the authority of a statute of the provincial legislature.[27] In the previous year planning boards in Ontario had been empowered by the legislature to investigate and survey the physical, social and economic conditions in their planning area and to prepare maps, drawings and other documentation essential to the study and solution of problems affecting their orderly development.[28] By 1949 an official plan for the metropolis had been prepared and a comprehensive zoning by-law passed by city council. At this stage Toronto's population approached 850,000.

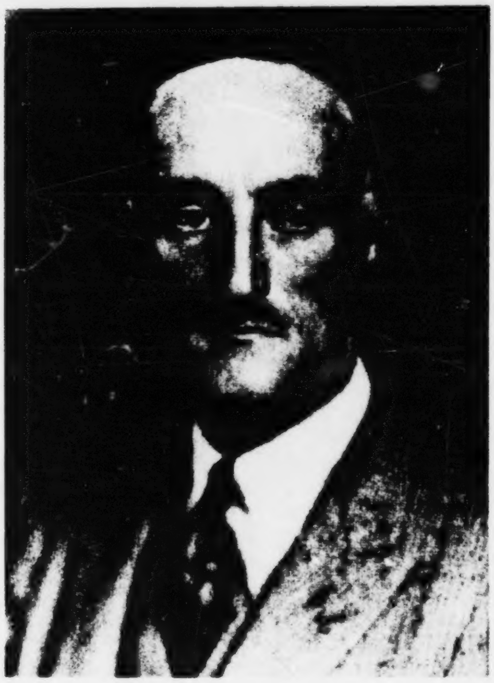


FIGURE 113. Tracy D. leMay.

From the early 1930s the English-born City Surveyor for Toronto, Tracy Deavin leMay, who had been awarded his Ontario land surveyor commission in 1909, developed a profound technical knowledge in all fields related to the planning, growth, and development of communities in general and of Toronto in particular. In this work he enjoyed the active support of A. Douglas Ford and W. J. Gordon Wadsworth, O.L.S., who became, in time and in succession, City Surveyor, and Director of Surveys, City of Toronto, respectively. The appointment of leMay as vice-president of the Town Planning Institute of Canada in 1953 crowned a long period of close and highly useful association with the work of that organization.

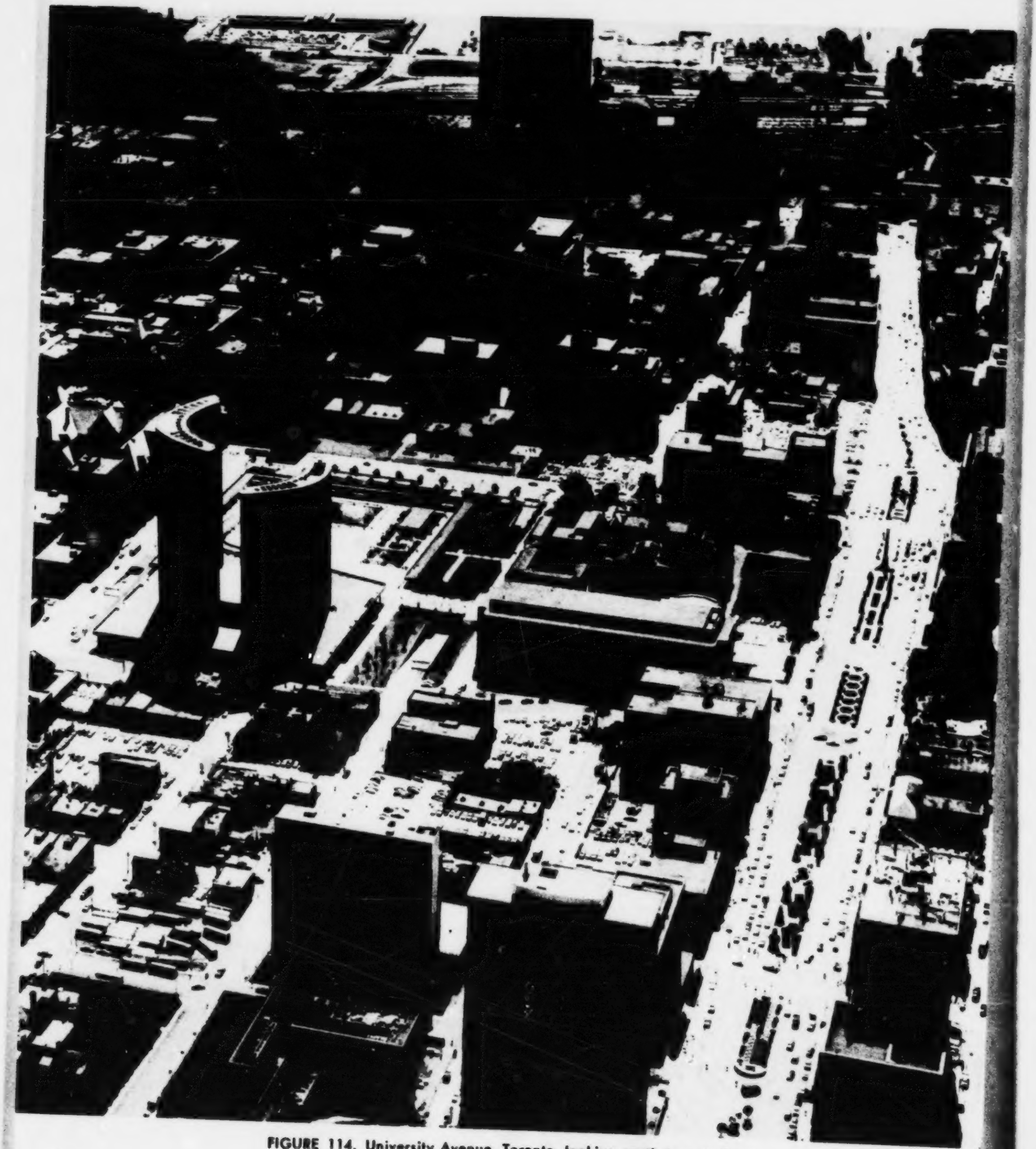


FIGURE 114. University Avenue, Toronto, looking south to waterfront.

Toronto inherited from surveying activities of the 19th century a broad grid of cross-town traffic arteries at 1¼-mile intervals, based on the location of original concession roads and side roads. From the outset certain old travelled roads failed to conform to the general survey pattern. Davenport Road, Dundas Street, Weston Road and Kingston Road, for example, cut irregularly across the prevailing survey grid. Actually these were highways used to reach the town of York before surveyed roads had been opened. Some of these roads may have followed the course of Indian trails. Later on streets within the subdivision grid of roads were joined to form additional cross-town arteries. College Street and Bay Street are examples of this type of development. A 1912 enactment authorized city authorities to widen to 86 feet, concession and side roads outside the existing city limits in advance of subdivision projects.

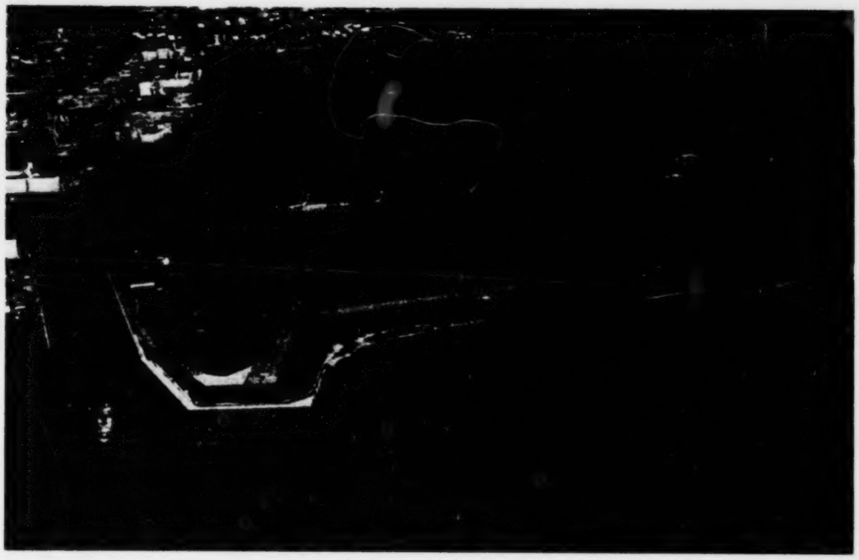


FIGURE 115. Toronto Island.

From the turn of the century, plans were made to improve the grid pattern by the construction of a system of impressive boulevards. In the 1929 report of the Advisory City Planning Commission it was proposed that University Avenue, which has become the bright jewel of central Toronto's thoroughfares, be extended as part of an over-all plan for the improvement of the downtown street pattern. It was recommended that the avenue be extended southward, then projected southeasterly to Front Street. The commission also recommended that all buildings to be constructed along University Avenue be made subject to reasonably high architectural standards. This declaration was the first clear echo to be heard in 20th-century Toronto of Governor Simcoe's town planning proclamations, issued in the earliest days of the settlement at York.

Downtown a large-scale program of street-widening, of rapid-transit construction and of expressway building became imperative. The construction of the first stage of an ambitiously designed subway system, a 4½-mile stretch along Yonge Street and extending from Eglinton Avenue to the Union (Railway) Station on Front Street, was commenced. In addition, for the first time in Metropolitan Toronto, a planning organization had created a framework of traffic arteries to expedite the rapid movement of motor vehicles. Lake Shore Boulevard, linking Queen Elizabeth Way with Kingston Road, was supplemented by the Gardiner Expressway. Highway 401 to the north, Highway 27 to the west, also provided access to the inner city, as did the Don Valley Parkway and Bayview Avenue extension. By the judicious placement of new expressways through ravines, much of this type of landscape was retained for park purposes. High Park, laid out at an early stage of the city's growth, on hilly terrain just east of the Humber River, continues to be outstanding among all parks in the city. Revolutionary changes in transportation routes and facilities foreshadowed a new distribution, within the city proper, of high-rise office and apartment buildings. This tendency toward decentralization of such structures soon became evident near the Bloor-Yonge, Yonge-St. Clair, and Eglinton-Yonge intersections.

In the decade following the end of the Second World War the most impressive feature of Metropolitan Toronto's growth was its large-scale suburban expansion, involving the rapid appropriation of large blocks of rural properties for urban uses. Open country continued to recede at an astonishing rate. The traditional grid system continued to form the basic pattern of growth. In time, serious efforts were made to establish less conventional and more attractive and cohesive communities within this immense suburban development. In Don Mills, for example, house types of considerable variety were built on unconventional street patterns, centred on a modern shopping and service complex.

Town and rural planning, by the mid-20th century, was receiving steadily increasing attention in all parts of Canada. It was becoming more widely recognized throughout the nation that good subdivision design, in addition to fitting the local topography, should include and ensure the most efficient use of land, permit the most economical installation of municipal services, promote health and safety as well as provide the maximum amenities of living. The land surveyor, in relation to such objectives, was fast becoming a servant of the development of land in our communities in the interests of its inhabitants through the creation of an improved environment for the Canadian way of life.

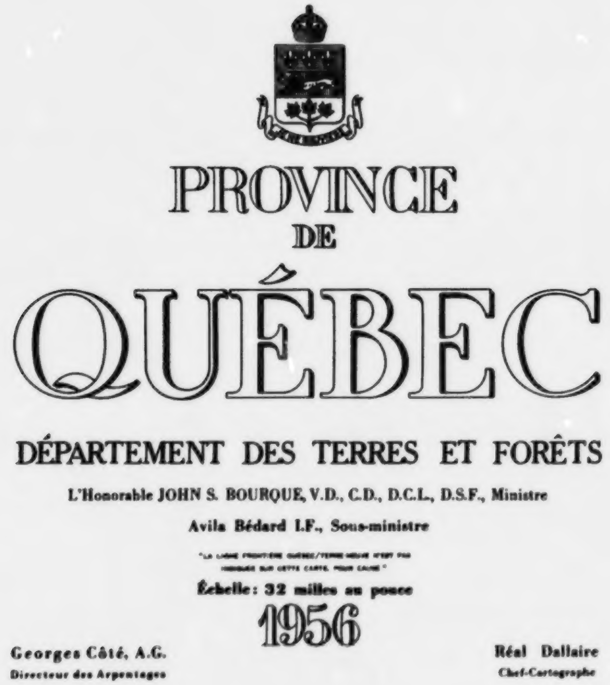
12

THE UNSURVEYED INTERPROVINCIAL BOUNDARY

> "*La ligne frontière Quebec/Terre Neuve n'est pas indiquée sur cette carte, pour cause.*"
>
> —Legend on maps of Quebec issued in 1946 *et seq.*
> by the Quebec provincial government.

The word "Labrador" began to appear on world maps in the early 16th century and was initially applied to what is now Greenland. Misunderstanding among cartographers of the period over the relative positions of Greenland and northern North America led, in time, to the transfer of the name "Labrador" to its present location. The Wolfenbuttel map, 1534, bears an inscription in Spanish with reference to the east coast of Greenland which reads, in part, "Land of the Labrador . . . discovered by the English of the town of Bristol and because he who gave the direction [the pilot] was a labrador of the Azores, they gave it that name."[1] The original meaning of "labrador" is not clear but the word, at that time, may have signified a farmer or laborer. By the time of the Sanson map of North America, 1696, the name was firmly attached to the mammoth peninsula between Hudson Bay and the Strait of Belle Isle.

The interprovincial boundary line between Quebec and Newfoundland in the Labrador peninsula, although legally defined, remains completely unsurveyed and unmarked on the ground. The roots of this paradox reach back more than three centuries into a period when fishing was the principal, perhaps only, industry of the region. Today, with large-scale water power developments, timber production, and intensive mining of high-grade iron ore as major economic activities in areas adjacent to the interprovincial border and, occasionally, astride it, the need to establish agreement on the actual course of the boundary as well as its definition on the ground, is more urgently needed than ever before.



PROVINCE
DE
QUÉBEC

DÉPARTEMENT DES TERRES ET FORÊTS

L'Honorable JOHN S. BOURQUE, V.D., C.D., D.C.L., D.S.F., Ministre

Avila Bédard I.F., Sous-ministre

Échelle: 32 milles au pouce

1956

Georges Côté, A.G.
Directeur des Arpentages

Réal Dallaire
Chef-Cartographe

FIGURE 116
Title, with explanatory clause, typical of maps of the province issued by the government of Quebec after 1945.

The boundary in Labrador between Quebec and Newfoundland, shown on maps published by the Canadian and Newfoundland governments during the past forty years, reflects the 1927 decision of the Judicial Committee of the Privy Council, London. It is over the validity of this judgment of British law lords, presided over by the then Lord Chancellor, Viscount Cave, that recent governments of Quebec have expressed reservations.

Origin of the Boundary Problem

As was demonstrated in the Canada-Alaska boundary dispute, disagreements in debates over location of a border often originate in ambiguously-worded, formal documents as well as in conflicting maps pertaining to the region in question. It is significant to find in the Labrador case, as in that of the Alaska Panhandle, that the term "coast" became the subject of various interpretations. However, the documents mainly involved in the Labrador case were those officially describing administrative responsibilities of governors of Newfoundland who served in that office during the decades immediately following the signing of the Treaty of Paris in 1763. It was in that year of the formal cession of Canada by France to Great Britain that the right to control Labrador fisheries was granted to Newfoundland. But soon thereafter Quebec fishermen, resident in the region, began to protest strongly against exclusion from their traditional fishing areas in the Strait of Belle Isle. As a result of these objections the administration of all Labrador was transferred to Quebec under terms of the Quebec Act, 1774.

From the opposite side complaints began to be made, in subsequent years, that the government of Quebec was not much concerned with Atlantic cod fisheries and that no real governing power was being exercised along the Labrador coast. Accordingly the British government decided to reverse its stand and, by the 1809 Newfoundland Act, it was enacted that parts of the coast of Labrador, from the St. John River to Hudson Strait "annexed to the Government of Newfoundland . . . in 1763, shall be separated from the said Government of Lower Canada and be again re-annexed to the Government of Newfoundland." Sixteen years later, under the (Imperial) 1825 British North America Act on Seigneurial Rights,* a boundary was established between the two jurisdictions with a southerly limit at ". . . a line to be drawn due north and south from the bay or harbour of Anse Sablon . . . ." The remainder of this line, apart from a reference to the 52nd parallel of north latitude, was described in rather general terms. But this Imperial legislation had the effect of transferring back to Lower Canada parts of the Labrador coast, west of the defined line. It marked the final statutory move in the 62-year-long game during which Labrador territory was tossed like a shuttlecock back and forth between jurisdictions.

But documentary evidence, other than treaties and legislative acts, also had a definite bearing on this important issue. Capt. Thomas Graves was Governor of Newfoundland at the time of the cession of Canada to Great Britain. On April 25, 1763, Graves was reappointed by King George III "King's Governor and Commander-in-Chief in and over our said island of Newfoundland *and all of the coasts of Labrador* [author's italics] from the entrance of Hudson Straits to the river St. John's which discharges itself into the sea nearly opposite the west end of the island of Anticosti . . . ." Instructions to Governor Graves under the Royal Sign Manual in accordance with the terms of the appointing Order-in-Council made no distinction between the island of Newfoundland and the coast of Labrador, both being included in identical terms in the territories under the care of the governor. In the various royal commissions issued to governors of Newfoundland succeeding Captain Graves, including Hugh Palliser, the language of the original documents was retained unaltered.[2]

The boundary dispute was revived when a discrepancy arose between the formal description of Newfoundland's jurisdiction in Labrador, as contained in Newfoundland letters of patent dated March 28, 1876, and a map of Labrador, published in 1880 by the federal Department of the Interior. Efforts to negotiate a compromise of this difference failed to produce any results and by the turn of the century the issue had come to a head. A legal confrontation was made inevitable when, in 1902, a pulp and lumber company was licensed by Newfoundland to operate in the Goose Bay area. The right of the company to cut timber in that vicinity was challenged by the government of Quebec. The matter was taken to the courts and in 1907 the governments of Canada and of Newfoundland agreed to refer the boundary question to the Judicial Committee of the Privy Council. The outbreak and duration of the First World War, coupled with an inability to settle on the precise wording of the reference to the court, resulted in additional delay. It was not until the early 1920s that the contending governments asked the law lords "What is the location and definition of the boundary between Canada and Newfoundland under the Statutes, Orders-in-Council and Proclamations?"

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*6 Geo. IV, ch. 59, Term 9.

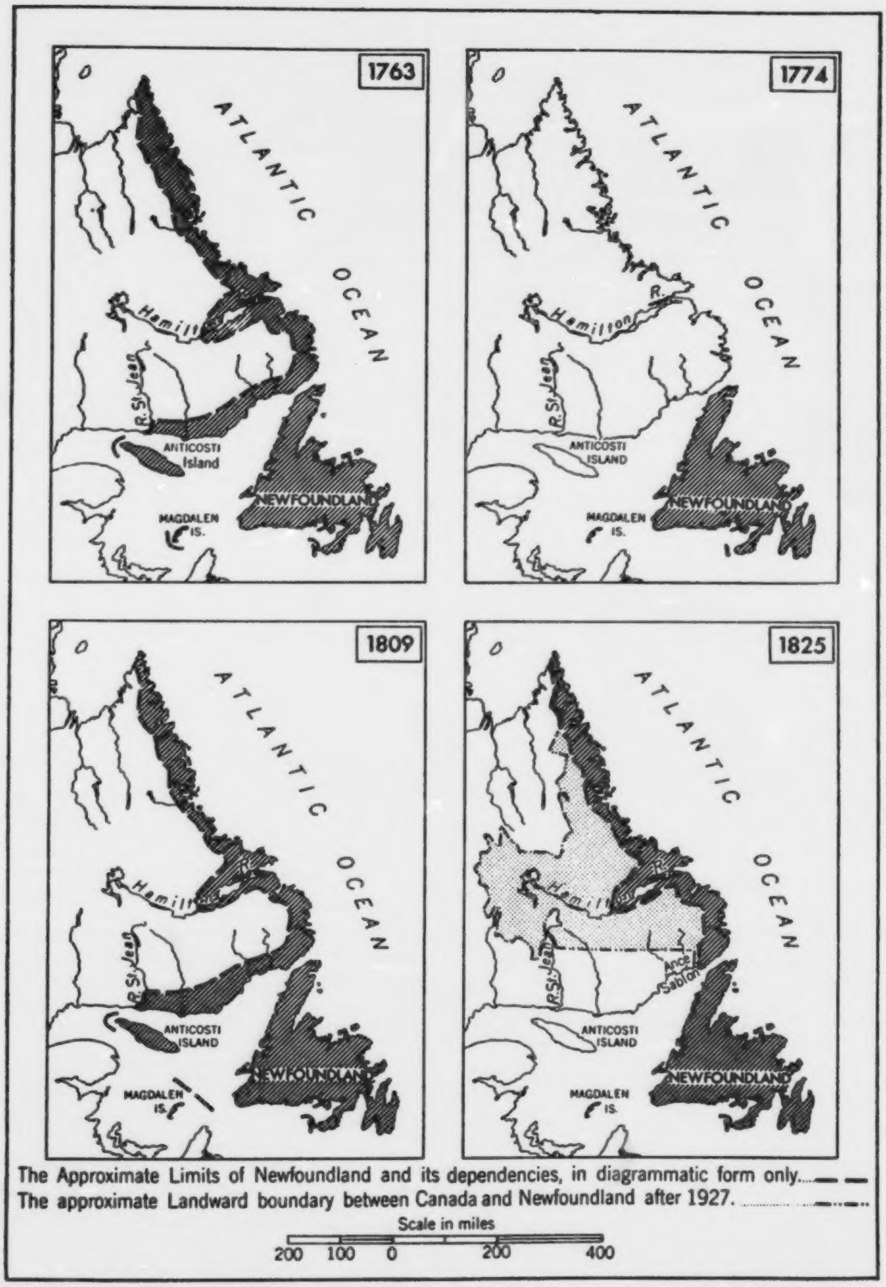
1763
1774
1809
1825
ATLANTIC OCEAN
Hamilton R.
R. St. Jean
ANTICOSTI Island
ANTICOSTI ISLAND
MAGDALEN IS.
NEWFOUNDLAND
Anse Sablon
The Approximate Limits of Newfoundland and its dependencies, in diagrammatic form only
The approximate Landward boundary between Canada and Newfoundland after 1927.
Scale in miles
200 100 0 200 400

FIGURE 117. Evolution of the boundaries of Newfoundland. Map from *Boundaries of Canada, Its Provinces and Territories*, by N. L. Nicholson. Queen's Printer, Ottawa, 1954. Geographical Memoir No. 2, Department of Mines and Technical Surveys, Ottawa.

The Privy Council Adjudication

The government of Quebec chose not to be represented at the hearing before the Privy Council, arguments at which consumed fourteen days up to November 15, 1926. From the terms of historical documents offered in evidence it was clear that there had never been any distinction made between the island of Newfoundland and the coast of Labrador. The law lords became convinced early in the proceedings that ownership of "the coast of Labrador" had become legally vested in the Colony of Newfoundland. The only question of magnitude left to their decision was that of the island extent of the term "the coast". The arguments of the chief counsel for Canada in this case, Rt. Hon. H. P. Macmillan, K.C., was that Newfoundland received only a coastal strip or fringe area of the Labrador peninsula. Sir John Simon, K.C., counsel-in-chief for Newfoundland in this hearing, contended that the boundary was a line "due north from Anse Sablon as far as the 52nd degree of north latitude . . . thence northwards to Cape Chidley along the crest of the watershed of the rivers flowing into the Atlantic Ocean."

The term "coast", capable as has been indicated of several interpretations, was construed by the law lords in its broader sense, namely, as including the hinterland as well as the shoreline fringe. This view, they pointed out, was consistent with the doctrine of international law by which legal occupation of a seacoast carries with it a right to the whole country drained by the rivers which empty their waters into that coastline. In the 18th and 19th centuries, their lordships pointed out, the word "coast" was used from time to time to denote a region, not merely a shoreline, as in the case of the Gold Coast in Africa.[3] In any event the law lords would have been at a loss to suggest any other boundary between the seacoast and watershed along which any sensible line could be drawn. In addition, the terms of the 1825 act, providing for the re-annexation to Lower Canada of "so much of the . . . coast as lies to the westward of a line to be drawn due north and south from the bay or harbour of Anse Sablon inclusive as far as the 52nd degree of north latitude" indicated that much more than a fringe territory or coastal strip was involved in these boundary transactions. Any narrow construction of the term

FIGURE 118
Levelling operations by members of Geodetic Survey of Canada at Hamilton Inlet, Labrador, prior to the Privy Council decision of 1927.

"coast" appeared inapplicable in view of the known fact that a ribbon of land along the Labrador shore would often consist of high cliffs inaccessible from the sea and therefore of little practical use in the prosecution of the fisheries.

On March 1, 1927, the decision of the Privy Council was made public. In the judgment it was stated that the boundary between Canada and Newfoundland in the Labrador peninsula consisted of "a line drawn due north from the eastern boundary of the bay or harbour of Anse Sablon as far as the fifty-second degree of north latitude, and from thence westward along that parallel until it reaches the Romaine River and then northward along the left or east bank of that river and its headwaters to their source and from thence due north to the crest of the watershed or height of land there and from thence westward and northward along the crest of the watershed of the rivers flowing into the Atlantic Ocean, until it reaches Cape Chidley."

The Geographical Aftermath

The Privy Council definition, commendably simple and concise at first glance, nevertheless soon deposited a heavy burden of precise ascertainment upon surveyors and mappers. Even the names and locations of the terminal points of the boundary line puzzled geographers. The southernmost point, at the mouth of the St. John River, referred to in the Privy Council judgment as "Ance Sablon" (sometimes alluded to in other special documents as "Anse Sablon") was originally christened "Ance au Blanc Sablon". In the Arrowsmith map of 1853 it is entered as "Blanc Sablon" and the place is known as such today. The precise location of Cape Chidley, the northern extremity of the defined boundary, remained in doubt for some years after the decision of the Privy Council. Cape Chidley was named, by John Davis in 1587, after "the worshipfull Mr. John Chidley in the countie of Devon". Chidley, incidentally, commanded in 1589 an expedition from England to the South Seas by way of the Strait of Magellan.[4]

On the Arrowsmith map of North America, issued under the authority of the House of Commons, London, in 1857, the name of the feature appears as "Cape Chudleigh". This spelling occurred occasionally on maps issued as recently as 1889 when, on June 10th of that year, the Canadian federal government geographer, John Johnston*, wrote a memorandum to Deputy Minister A. M. Burgess, Department of the Interior, Ottawa. On a map prepared by Johnston to accompany the memorandum, a sketch based on maps published by Arrowsmith of London and by W. and A. K. Johnston of Edinburgh, the Canadian cartographer followed the custom of marking the boundary of Labrador "southerly from cape Chudleigh [at the ocean entrance to Hudson's strait, along the height of land] to the undefined southern boundary of Lower Canada to Anse Sablon". John Johnston commented that "it does not appear that this line was intended by the geographers to represent the boundary of the territory in Labrador under the jurisdiction of Newfoundland, but most probably the dividing line between Labrador and what was supposed to be Hudson's Bay Company's territory . . . On the maps of the Dominion published from time to time by this department [Interior] the same system of drawing the Labrador line has been followed as on the British maps, but we have invariably taken the precaution to show it in a dotted line, with the word "supposed" or "undefined" applied to it."[5] Canadian government authorities on nomenclature have since ruled that "Cape Chidley" is the correct spelling of that geographical feature.[6]

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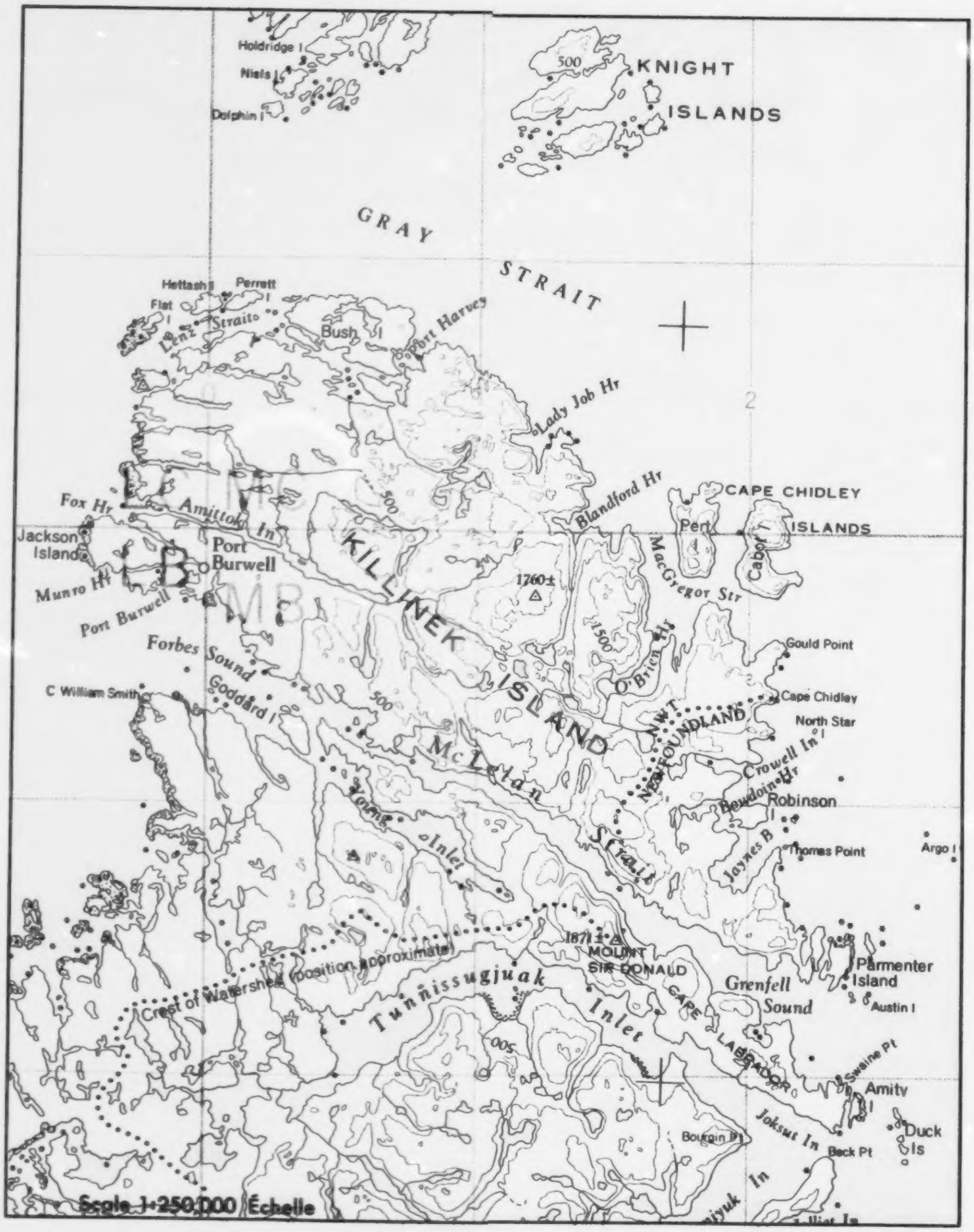
*A cartographer and member of the family which owned the well-known Edinburgh map publishing firm. He was brought to Canada by Governor General Lord Dufferin.


Holdridge I
Niels I
Dolphin I
500
KNIGHT
ISLANDS
GRAY
STRAIT
Hettasch I
Perrett I
Flat I
Lenz Straits
Bush I
Port Harvey
Lady Job Hr
2
Blandford Hr
CAPE CHIDLEY
ISLANDS
Pert
Cabot
Fox Hr
Amittok In
Jackson Island
Port Burwell
Munro Hr
Port Burwell
KILLINEK ISLAND
1760±
MacGregor Str
1500
O'Brien Hr
Gould Point
Cape Chidley
North Star I
Forbes Sound
C William Smith
Goddard I
500
N.W.T.
NEWFOUNDLAND
McLelan Strait
Crowell In
Beudoin Hr
Robinson I
Thomas Point
Argo I
Jaynes B
Young Inlet
1871±
MOUNT SIR DONALD
Grenfell Sound
Parmenter Island
Austin I
Crest of Watershed (position approximate)
Tunnissugjuak Inlet
500
CAPE LABRADOR
Swaine Pt
Amity I
Duck Is
Bourgin Pt
Joksut In
Beck Pt
Scale 1:250,000 Échelle

MAP 4. Part of the Quebec-Newfoundland boundary to terminus at Cape Chidley.

In 1931, 1932 and 1935 flights were made from Boston to the coast of Labrador in a Fairchild seaplane by a group of explorers sponsored by the American Geographical Society. These flights by Alexander Forbes, C. J. Hubbard, O. M. Miller and colleagues were made in the prosecution of an aerial survey of northern Labrador, initially to test the then new method of producing topographical mapping from oblique aerial photographs. As a result of these efforts the Society published in 1936 Map Sheet No. 1, Cape Chidley, on a scale of 1:100,000. This map showed the cape to be on what is now known as Cabot Island, one of two small islands lying off the northeastern coast of Killinek Island which, in turn, is separated from the Labrador mainland by McLelan Strait.[7]

The publication of this map led to a reference on January 14, 1936, to the Department of Justice, Ottawa (Deputy Minister W. Stuart Edwards) by the Topographical and Survey Bureau, through the parent Department of the Interior (Deputy Minister J. M. Wardle) for a ruling on whether Port Burwell, on the west coast of Killinek Island, was in Newfoundland or in Quebec or in the Northwest Territories. The opinion of the Justice Department was contained in a memorandum dated February 17, 1936, (J. R. 1304/36) in which it was pointed out that the judgment of the Privy Council in 1927 did not profess to determine the location of Cape Chidley. The law lords did, however, include with their judgment a sketch map serving to illustrate the rival claims as to the course of the boundary. On this map Cape Chidley is marked as being on a promontory on the northeastern coast of Killinek Island. This location was confirmed by maps submitted in evidence at the London hearing by both Canada and Newfoundland.

In the Justice Department's memorandum it was also stated that "it is a reasonable assumption that their Lordships intended Cape Chidley, as so depicted, to be taken as the point designated in their judgment as the northern terminus of the boundary; and this notwithstanding that the watershed of the rivers flowing into the Atlantic Ocean northward along whose crest the judgment requires the boundary to be traced until it reaches Cape Chidley, may not be . . . a continuous watershed . . . Upon this view Port Burwell, which is located on the western side of Killinek Island, would be within the Dominion of Canada." After coming to this decision, namely, that Port Burwell was not in Newfoundland, the author of the memorandum concluded that, in the light of the Quebec Boundaries Extension Act* and the Northwest Territories Act† all that part of Killinek Island, including Port Burwell, lying west of the boundary line linking Cape Chidley with the mainland, would be in the Northwest Territories, rather than in the province of Quebec.

In June, 1936, Surveyor General Peters, Ottawa, sent to O.M. Miller in New York City information on the most recent astronomic positions established by the Geodetic Survey of Canada for Port Burwell and nearby Lady Job Harbour. Miller, in acknowledging the data on these determinations, commented that the information "makes the aerial triangulation by oblique aerial photographs between Port Burwell and the astronomic position at the origin of our survey, much more precise."[8] Some cartographers have suggested that the name "Cape Chidley" ought to apply to an area rather than to a mathematically calculated point. The Canadian government ruling, however, is that Cape Chidley is the promontory located on the northeastern coast of Killinek Island at 60°23′ north latitude and 64°27′ west longitude.[9]

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*Statutes of Canada, 1912, ch. 45, sec. 2.
†R.S.C., 1927, ch. 142, sec. 2.

For many years after the London settlement the governments directly affected by the Labrador boundary problem made no attempt to have the boundary officially surveyed and marked on the ground. Possibly this indifference resulted from the fact that so much of the hinterland involved was relatively inaccessible and appeared, at the time, to be of little worth in any significant economic sense. Only after the timber resources of the peninsula began to be exploited by private interests were definite steps taken by public authorities to obtain a judicial ruling in the matter. The loudest reverberations aroused by the 1927 decision had hardly died away when public and private attitudes underwent a convulsive change and for the first time there developed a widespread and acute awareness in Canada of the Privy Council award and its various implications.

There have been few Canadian studies in depth of the Labrador boundary question but one highly authoritative work on the subject is the volume written by Henri Dorion entitled "La Frontière Québec-Terreneuve", published by Les Presses de l'Université Laval in 1963. A considerable number of magazine and newspaper articles have appeared, dealing with various aspects of the subject. Special mention should be made of "The Labrador Frontier" by F. Kenneth Hare in *The Geographical Review*, volume 42, (1952), no. 3; also "La Frontière Canada-Labrador" by Gérard Gardner in *Revue Trimestrielle Canadienne*, volume 24, no. 95, p. 272, published in September, 1938, by École Polytechnique, Montreal; and a recent series of newspaper articles appearing in *Le Devoir*, Montreal.

In a contribution to *Perspectives*, Montreal, no. 43, (October 24, 1964), entitled "Labrador (via Londres) Ou La Frontière Inventée (Labrador, via London, or the Trumped-Up Boundary)" Henri Dorion provides a summary of the situation as well as insights of the Quebecker's point of view. According to the editor's accompanying comment on this article Dorion made his presentation "avec science, mais aussi avec humour". After making reference to "Mother Ottawa" inviting "Grandmother London" to solve the boundary definition problem, Dorion pointed out that the Judicial Committee of the Privy Council became, in effect, at one and the same time, judge of the dispute as well as a party to it. "Ainsi dans cette affaire . . le Conseil Privé de Londres devenait-il, en un sens, à la fois juge et partie." In addition Dorion claimed that Quebec was not formally consulted before the boundary case was placed by Ottawa before the Privy Council. The Labrador question, the writer asserted, as reviewed in London, turned on concepts as well as on facts . . . ". . . a porté sur des concepts autant que sur des faits". Since the outcome of the hearings depended, to an important extent, on the judicial concept of the term "coast" Dorion expressed the conviction that Their Lordships had given an excessively generous meaning to the word. He felt that the ruling on its interpretation was as ludicrous as claiming that a part of Alberta could be said to be on the coast of the Gulf of Mexico. In resolving the question the Privy Council had given to Newfoundland an area three times as large as the island itself, thus permitting "la grenouille de se faire presque aussi grosse que le boeuf (the frog to become nearly as big as the ox)."

Dorion proceeded to state: "Le Canada réclama devant le tribunal toute la péninsule, a l'exception d'une étroite bande côtière d'un mille de profondeur sur toute l'étendue de la côte, ce qui n'etait pas loin de constituer une insulte au bons sens. De son côté, Terreneuve manifestait un appétit considérable, en réclamant des territoires s'enfoncant jusqu'au coeur de continent. Entre ces deux solutions également extrêmes, également illogiques, les juges anglais se fixerènt d'en choisir une, à l'exclusion de tout autre intermédiaire qui aurait mieux servi la logique, le bons sens et peut-être, en même temps, la

justice. [Before the tribunal Canada claimed the whole peninsula, with the exception of a narrow, one-mile-deep coastal strip, which was not far from being an insult to common sense. For its part Newfoundland revealed a huge appetite by claiming territories penetrating to the heart of the continent. Between these two equally extreme and equally illogical solutions the English judges decided to choose one, excluding any other compromise which would have better served logic, common sense and, perhaps, justice.]"

Iron Ore and the Boundary

In 1929 a mining firm, New Quebec Company Limited, obtained from the province of Quebec a special exploration licence covering some 2,100 square miles, a huge block of territory situated north of the hinterland region that had been awarded to Newfoundland two years earlier. Soon afterward a second special licence was issued to Richard S. Denning and R. B. Daigle on an adjacent area. Two Canadian geologists, W. F. James and J. E. Gill, completed the first scientific investigation of the 20th century in the region, and Gill made the first important discovery of iron ore near Ruth Lake, not far from Knob Lake. All this activity took place in 1929. Up until that time most prospectors in Labrador had been occupied mainly with the search for gold.

In the meantime consideration was being given in Ottawa to the possibility of carrying out a survey to mark the defined Labrador boundary on the ground as this line, at the time, was not an interprovincial border but a line more in the nature of an international boundary. On October 7, 1931, Richard William Cautley (1873-1953), then Acting Chief of Control Surveys, Topographical Survey of Canada, in a memorandum addressed to Surveyor General Peters, recommended that the cost of a complete survey of the Quebec-Newfoundland boundary in Labrador would be quite prohibitive. "From a survey point of view", Cautley stated, "the delineation of the Labrador boundary will be a tremendous undertaking presenting great difficulties of transportation. In the first place the boundary as indicated on existing maps is more than 1,400 miles long — 320 miles of straight line and 1,120 miles of height of land. In the second place, most of the boundary line is difficult of access . . . approximately half the territory awarded to Newfoundland in Labrador is more than 2,000 feet above sea level, while the Torngat Mountains rise to more than 4,000 feet, which probably means that the rivers flowing to the Atlantic Ocean are comparatively useless for purposes of navigation.

"The most useful and practicable form of complete boundary survey would perhaps be a triangulation tied in to monuments placed at clearly defined points along heights of land, which might be supplemented as to detail by an aerial strip flight. The transportation problems involved in such a survey would be difficult and very expensive . . . Having regard to the uninhabited nature of the country and the little that is known at the present time of the potential value of its natural resources I suggest . . . that all that is really needed is an astronomic determination of various points along the boundary which would enable us to rectify its position on future maps . . ."[10]

In deciding not to proceed with the marking of the boundary on the ground in the 1930s federal authorities passed up the last opportunity to make such a survey on their own initiative. The war years diverted administrative energies at Ottawa to other pressing tasks, and the entry of Newfoundland into Confederation meant that invitations from both provinces concerned constituted a condition precedent to any federal participation in such a project.

The existence of iron deposits in Labrador had been known for some time but the richness and extent of these deposits, until Gill's discovery in 1929, had been only dimly realized. Because of the remoteness of the area from large industrial communities and the onset of the economic depression, private enterprise had shown no interest in the latent opportunities in the region for intensive mineral development. But in the late 1930s and early 1940s fears began to be felt in steel-making circles for the future of the famous Mesabi Range in the United States, a district which, for many years, had been the principal source of iron ore for that American industry. It appeared that at long last the reserves of that Range were beginning to wane and that another North American field of comparable size and richness had to be found and developed quickly.

As early as 1866 Rev. Louis Babel, O.M.I. had made annual visits to the Labrador hinterland. In addition to making sketches of the travel routes he followed, Father Babel compiled a useful map of the region. In view of the imperfection of his instruments the accuracy of his map was truly remarkable. He continued to investigate the entire area until 1870. In 1873 the Department of Crown Lands published a Babel map on which a region had been marked as being "full of iron (abondante en fer)". Unhappily the map was not accompanied by any report although the missionary may have made a written communication on the subject to his ecclesiastical superiors.

A. P. Low of the Geological Survey of Canada, during field seasons from 1892 to 1895 inclusive, conducted expeditions along the principal rivers and lakes of the Labrador Peninsula. In three of those years D. I. V. Eaton acted as assistant and topographer.

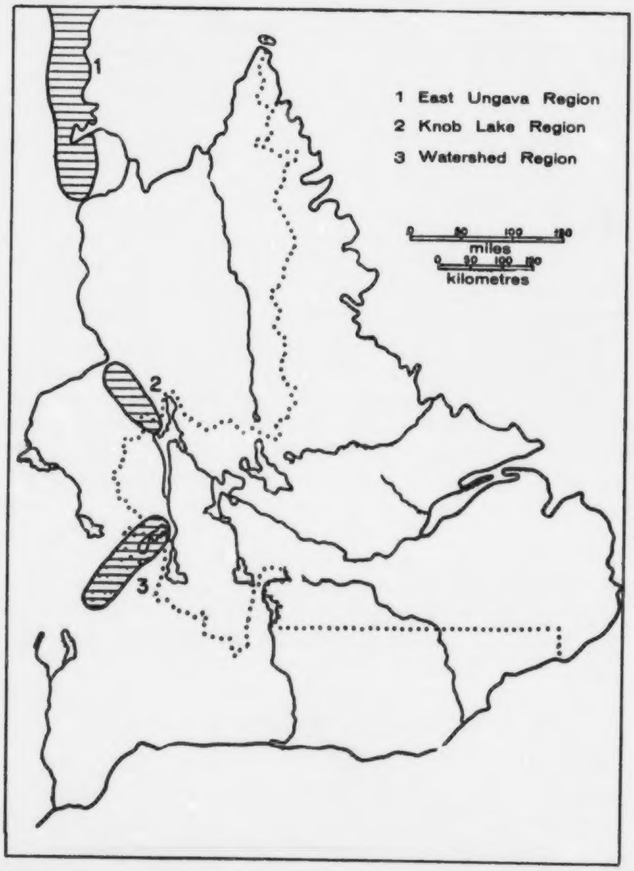

FIGURE 119
Mineral regions of Labrador. Dotted line indicates boundary according to Privy Council decision, 1927. Map from *Mining Activities in Labrador, Ungava*. Graham Humphrys, Montreal, 1959.

Eaton compiled a map to accompany Low's formidable report covering the entire four seasons of investigation. "The immense deposits of magnetite, hematite and siderite in the Cambrian formation, and their widespread distribution, may at some future date be of economic importance, especially those containing a large amount of manganese," Low prophesied. In one locality Low observed that "exposures of iron-bearing rocks are almost continuous and the amount of ore in sight must be reckoned in the hundreds of millions of tons. There is certainly", he added, "an almost inexhaustible supply of high grade ore."[11]

Not many months after the District of Ungava was officially annexed to the province of Quebec in 1912 and became known as New Quebec, a prospector, R. B. Daigle, investigated the watershed region of the Labrador hinterland. Daigle was, in fact, the first prospector to stake mining claims in that part of Quebec.[12] Although he was particularly active in the area in the seasons 1914 and 1915 Daigle continued his probes in subsequent years. Unfortunately written records descriptive of his travels and observations do not appear to exist.

The name of Joseph A. Retty (1904-1961), born at Fort Coulonge, Quebec, will always be associated prominently with the advent of large-scale mining developments in the Labrador wilderness. During the period 1936 to 1938, with the valuable assistance of an Indian trapper, Mathieu André, Retty proved the existence of at least 100 million tons of high-grade iron ore in New Quebec, centred upon an important find at Burnt Creek. The largest of these newly-discovered ore bodies lay directly across the Quebec-Labrador boundary. Retty, as a student, had been associated, from 1924 to 1929 inclusive, with field parties of the Geological Survey of Canada. In the 1930s he was employed by the Quebec Bureau of Mines and wrote several geological reports of importance on areas in that province which were published by that government agency. In 1936 Retty joined the Labrador Mining and Exploration Company as a consultant. Dr. Retty once concisely described the Labrador Trough, in which the richest and most extensive deposits of the metal occur, as assuming a typical corrugated [rock] pattern due to the alternation of northwest-trending ridges and linear lakes, the characteristic topographical expression of folded strata. Retty echoed, incidentally, the grievances of Canadian surveyors and mappers from the days of Samuel de Champlain concerning black flies and mosquitoes, and expressed the conviction that "undoubtedly this [Labrador] region is the source of supply [for these insect pests] for the entire universe."[13] By 1942 Hollinger interests had acquired effective control of mining rights in the areas reported on by Retty. Seven years later these interests, with the M. A. Hanna Company and in conjunction with a group of American steel firms, formed the Iron Ore Company of Canada.

A rapid evolution in forms of civilian transportation, following the Second World War, accompanied the revolution in general attitudes of Canadians and Americans towards Labrador. The canoe route into the hinterland from Sept-Iles up the Moisie River was slow, difficult and, in modern terms, impracticable. Indians of the region required at least one month to negotiate the first 150 miles of this turbulent waterway. Because of this transportation barrier the area remained largely unexamined and underdeveloped for at least three decades after publication of Low's notable report. But the use of aircraft swiftly altered the situation. Planes were particularly useful in freighting from tidewater to inland field parties and contributed greatly to the rapid construction of the Quebec, North Shore and Labrador Railway, a subsidiary of the Iron Ore Company of Canada. This rail line, work on the construction of which began in 1947, crossed 358 miles of difficult terrain from Sept-Iles to Knob Lake. Surveys for the building of this line, the

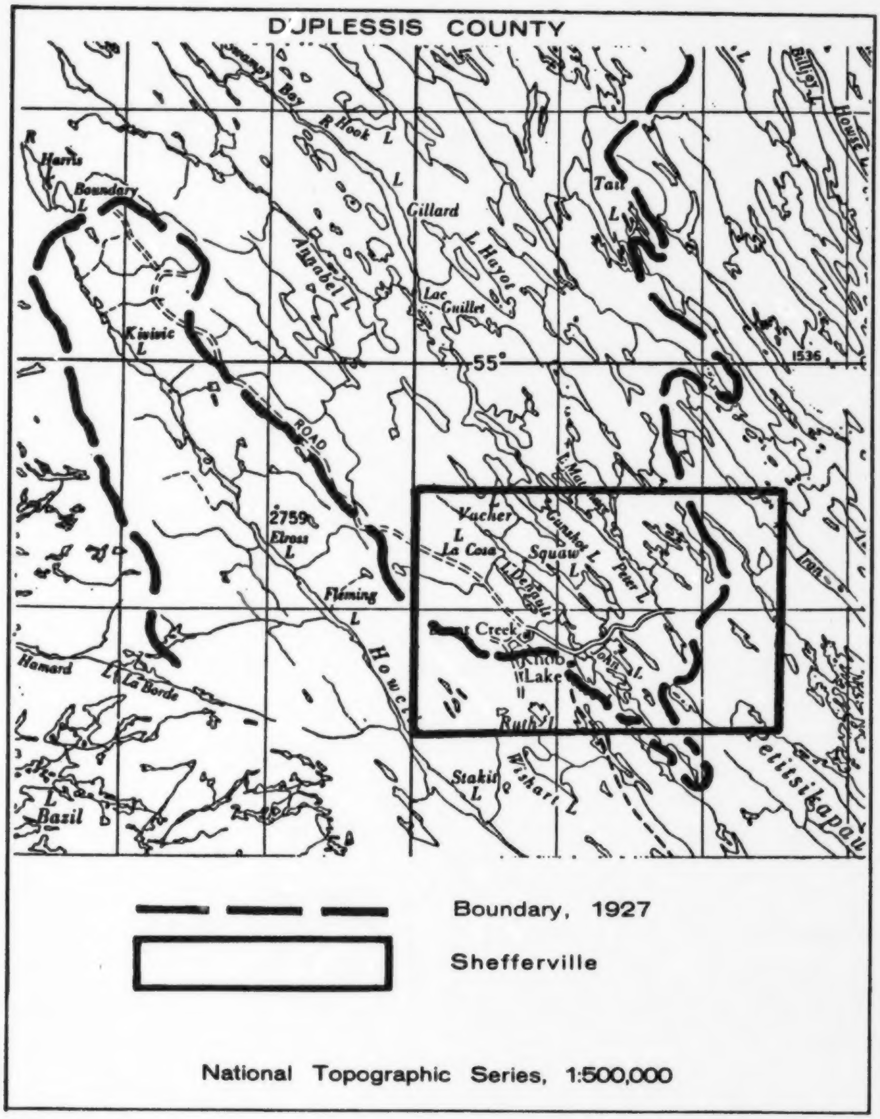
DUPLESSIS COUNTY
Harris
Boundary L
Hook L
Gillard
Attikamagen L
Hayot L
Lac Guillet
Tait L
Kivivic L
55°
1536
ROAD
2759
Elross L
Vacher L
La Cosa
Squaw L
Peter L
Fleming L
Creek
Knob Lake
John L
Ruth L
Howells
Hamard
La Borde
Bazil
Stakit L
Wishart L
Petitsikapau
Iron
Howse L
Boundary, 1927
Shefferville
National Topographic Series, 1:500,000

FIGURE 120. Map sketch showing course of boundary line through the Schefferville locality. Map from *La Frontière Quebec–Terreneuve*, Henri Dorion, Laval University Press, 1963.

stretch between Mile 150.8 and Mile 356 being located in Newfoundland Labrador, involved the building of two major bridges, one over the Moisie River the other over the Hamilton River. The first spike in rail construction was driven on November 10, 1950, at Sept-Iles by the then mayor of that community, P. J. Romeril. On February 13, 1954, at a special ceremony at Schefferville, the president of Hollinger Consolidated Gold Mines Limited, Jules R. Timmins, hammered home the golden spike marking the completion of the line.[14] Sept-Iles was 952 miles from Cleveland by water, through the St.

Lawrence Waterway and the Great Lakes. The movement of iron ore, in economic quantities, over this route was dependent upon the completion of the St. Lawrence Seaway. All these engineering tasks coincided with and were spurred by a mounting demand for iron ore by the steel industries of the United States and Canada.

Yet another significant natural resource development in New Quebec-Labrador during the immediate post-war period, foreshadowing the establishment of one of the world's major sources of hydro-electric energy, was the opening in 1954 of the Ste Marguerite Power Company, situated on the river of that name. With other local sources, power for the operation of mineral processing plants and for mining communities was thus made available. In the same year the town of Schefferville, adjacent to Knob Lake, was incorporated. On the surveying and mapping side, much had been accomplished that was basic to this impressive economic expansion. By the end of 1950 nearly 15,000 square miles had been mapped, 40,000 aerial photographs taken, and about $10,000,000.00 spent on exploratory work. In addition, standard geological surveys and geophysical examinations were employed extensively in the search for iron ore. A major function in these operations was the mapping of rock formations and the use of maps as guides in the hunt for iron ore deposits. All types of geological mapping were used in these explorations ranging from rough reconnaissance work to the most refined, detailed cartography.[15]

The story of Quebec's boundaries with other provinces and any account of surveying and mapping in Quebec, fundamental to its progress in mining, would be incomplete without reference to the substantial contribution made in these occupations by Dr. Georges Côté (1894-). After spending several summers with survey parties in wilderness areas of the province Côté, in 1915 and at the age of 21, received a degree in surveying from Laval University. In the same year he entered practice as a Quebec land surveyor and, in 1916, was commissioned a Dominion land surveyor. This vigorous Canadian, whose highly adventurous career was crowned by promotion to a key post in the provincial government service, namely, "Directeur de la division territoriale et commissaire des frontières", narrowly escaped death in the field on several occasions.

In 1918 Côté was the only member of a party of four surveyors to escape drowning in the Megiscane River in the Abitibi country. "Seated in two 18-foot canoes, loaded with several thousand pounds of equipment and provisions," he has recalled, "we were being carried swiftly downstream by a strong current when the first of our two canoes suddenly struck a submerged obstacle and split in two. Both occupants disappeared in

FIGURE 121. Georges Côté.

the turbulent water and were not seen again. The canoe in which I rode was steered partly clear of the wrecked craft but we also overturned. I managed to grasp hold of the canoe which had come to rest against some rocks, injuring my knee and arm. Finally I made it to shore with the utmost difficulty."[16]

On a later occasion in a part of the province, where serious forest fires began all too frequently without much warning in the heat of summer, a survey party of eight persons, including Côté, was crossing a heavily wooded area when all of them were suddenly enveloped in thick clouds of smoke that shut out the sun from their sight. After contriving in some manner to obtain their bearings the hardpressed men finally reached a lake. The body of water provided them with protection until the inferno of flames swept by. On yet another trip several surveyors in the field party became gravely ill from what seemed at the time a highly mysterious ailment. The sickness was traced to nitroglycerine poisoning produced by eating biscuits from a discarded dynamite container. The diagnosis of the trouble was made just in time to avert fatal consequences.

By 1921 young Côté had become a surveys inspector in the provincial government organization and, seven years later, director of surveys in the province. Before long he took another step up the ladder of promotion to the post of superintendent of land surveys, a position he occupied until 1943. Then, at the age of 49, Georges Côté was appointed director of the cadastral service. Since 1963 he has been director of land division and commissioner of boundaries as well as a consistent advocate of Quebec's claim to the Labrador hinterland.

The eastern boundary of Canada created by the Privy Council decision of 1927 remained in force for only 22 years. In 1949 Newfoundland entered Confederation, becoming Canada's tenth province and what had been, in essence, an international boundary became an interprovincial boundary. The Labrador boundary of the newest province, as defined by the Judicial Committee of the Privy Council, was incorporated in the terms of union. This constitutional development gave rise to novel problems, mainly concerning Canada's jurisdiction over territorial waters in the Atlantic Ocean. This, however, is a subject outside the scope of *Men and Meridians*. If the entry of Newfoundland into Confederation created some completely new problems of that nature, it also served to refocus attention on, and give fresh impetus to, the matter of the land boundary separating the new province from Quebec. As already noted, Quebec provincial government maps, from 1946 on, have continued to ignore the existence of the judicially-defined line, each official map sheet including, as part of its legend, the explanatory statement quoted at the head of this chapter.

Federal survey authorities are powerless, under law, to intervene in any boundary line determination in the absence of express invitations to do so from provinces directly concerned. But boundary commissions, including the person of the federal Surveyor General, whether the dispute involved two provinces or a province and a territory, have hardly been rarities in the course of Canada's development. On seven such commissions, including the Ontario-Manitoba Boundary Commission, the Surveyor General of Canada has been a member and it has been customary to name him to act as commission chairman. But, at present, there are no signs indicating a disposition to call in any federal authority to assist in surveying and marking on the ground a line between Quebec and Newfoundland territory in Labrador, a line that has become one of the most important boundaries within Canada.

13

CANADIAN ASTRONOMY: THE STEWART-PLASKETT PERIOD

> *"Are all celestial bodies but one globe*
> *As is the substance of this centric earth?"*
>
> —Marlowe: *Doctor Faustus*

The first stage in the progress of Canadian astronomy, that of isolated astronomical observations used mainly in land surveying, came to an end with the completion and occupation of the Dominion Astronomical Observatory in Ottawa in 1905. During most of the period covered by the second stage in that story, Dr. William Frederick King, as Canada's first director of the Ottawa observatory, remained at the summit of its affairs. It was a period in which Canadian interest, in official circles and on the part of the general public, quickened in matters astronomical as well as in the pursuit of earth studies. In the year in which the Ottawa observatory opened, the annual Gold Medal Award of the Royal Astronomical Society of Canada was established to encourage the study of astronomy in this country. On each occasion the medal was to be presented to the student leading in first-class honors in the astronomy division, University of Toronto, in his or her graduating year. The first recipient of the award was William Edmund Harper (1878-1940), born in Bruce County, Ontario, and educated in Owen Sound before he proceeded to the University of Toronto. Harper, in 1906, was actually the first to graduate in the university's newly-established course in astronomy. Within a few minutes after his graduation Harper accepted an invitation to join the staff of the Dominion Observatory in Ottawa. He began a career in this branch of science, a career that reached its climax in his appointment to the post of director of the Victoria Astrophysical Observatory thirty years later.

At the dawn of this second era in Canada (1905-1918) the study of astronomy at Canadian universities began a new chapter. The science was elevated to the status of a separate department at the University of Toronto with Professor Clarence Augustus Chant (1865-1956) as its head after 1904. It was in this department that most of the astronomers who manned Canadian observatories during the first half of the 20th century, received their early training for this type of work.

The initial years at the Ottawa observatory were mainly occupied with tasks of organizing various aspects of its principal functions. At the outset the divisions established were those of Surveys, Meridian Work and Time Service, Astrophysics and Solar Research as well as Geophysics. In the latter division, Seismology, Terrestrial Magnetism, and Gravity were included. By the close of the second stage in the progress of Canadian astronomy and earth sciences these three activities had become self-contained divisions. Dr. Otto Julius Klotz had, in fact, been placed in charge of Geophysics from the beginning. In 1907 Canadians began to participate in international conferences on seismology. Within a few years, and just as soon as newly-purchased instruments could be put in operating order, the Division of Astrophysics was replaced by Solar Physics, the Fifteen-Inch Equatorial, and Photographic Photometry. An important part of the earlier activities of the observatory staff was the work they performed in the course of surveying Canada's international boundaries. A start was made in this period also in geodetic survey work. Dr. King was named first Superintendent of the Geodetic Survey of Canada in 1909. Boundary-line surveys and the Geodetic Survey remained under Dr. King until his death on April 23, 1916. In 1917 these activities were separated from the observatory and established as separate entities. Thereupon the Dominion Observatory was organized on a seven-division basis: Astronomy of Position, including the Meridian Work and Time Service; Solar Physics; the Fifteen-Inch Equatorial (telescope); Photographic Photometry; Seismology; Terrestrial Magnetism, and Gravity.

For a span of 18 months after the onset of Dr. King's fatal illness the observatory organization remained leaderless and drifting. At the time of King's death the First World War had been taking its awful toll in human life for many months. Canadian casualties had been heavy and patriotic emotions, occasionally exercised in cruel forms, had been deeply stirred in most parts of the country. Undoubtedly there was some hesitation in high government circles in Ottawa to name anyone with such a Teutonic name as Otto Klotz to a position in the civil service of a fairly sensitive wartime nature. Under the circumstances this was an attitude decidedly unfair to a man of the outstanding character, attainments, and record of service of Dr. Klotz, as well as deeply repugnant to one of his proud temperament.

In the 50th year of his faithfully-kept daily diary and, in particular, on May 17, 1917, Klotz records his interview with Sir Thomas White when he approached the Minister of Finance in the Borden government in order to invite him to address the University Club of Ottawa: "As I was leaving I said to Sir Thomas, 'I am somewhat disappointed that I have not yet been appointed as successor to Dr. King at the observatory'. 'Aren't you the head of the observatory?' he asked. 'No', I replied. 'This is the first I have heard of it', he continued . . . I simply said 'it appears my name and name alone — it's German, I know — is the reason' and I bowed myself out."[1]

Early in July Klotz noted that "things at the observatory are in a most unsatisfactory condition, going from bad to worse . . ." By this time he had persuaded the chairman of the Civil Service Commission to bring the deteriorating situation to the attention of the Prime Minister. In the meanwhile Dr. Klotz had been named chairman of the Scientific Committee of the Seismological Society of America. At about this stage of affairs all the members of the scientific staff of the observatory, men such as J. Macoun, W. E. Harper, C. A. French, J. B. Cannon and R. J. McDiarmid, signed a petition to the Minister of the Interior calling for the promotion of Klotz. When Klotz read this document he wrote in his diary that "my heart beat fast — I trust it will be the death knell to chaos at the observatory".

The Klotz Regime

By the end of September, 1917, the long-awaited appointment was made and the *Ottawa Journal*, on October 1st, announced in headlines that "Dr. Otto Klotz, Chief Now at Observatory. Has been with the Dominion Government since 1879." One of the most moving passages in the Klotz diaries was written at this time: "I was alone now in the Director's [my] room. I sat down in the chair of my predecessor, Dr. W. F. King, and a flood of thoughts and memories rushed through my mind. I saw the panorama of the inception of astronomic work in 1885 by me, King joining therein in 1887, and how, by degrees, the work grew. Government recognition of it took shape when Hon. Clifford Sifton gave us the privilege of having an observatory creditable to Canada, in fact one 'beyond our dreams'. King and I were told to select a site on government land. The present site was selected by me. The plan of the observatory is a combination of our ideas. I believe that the 15-inch was our first plan. I went to Pittsburgh and to Cleveland about the dome . . . and to London, England, Troughton and Simms, about the large transit which was ordered by King against my advice . . . and how our work prospered and we built up a reputation in the various branches which we preserved. The panorama of 32 years unfolded itself in clear outline and I felt that the goal of my ambition, or rather the crowning event of a long life of honest endeavor and work, is found in the achievement of the position *Director of the Dominion Astronomical Observatory*." Little did Dr. Klotz realize at that lofty moment in his lengthy and distinguished career, that not much more than five years of life remained to him.

Something on the lighter side of the new director's methods of operation is revealed in the experience of a post-war recruit to the observatory staff, Russell Glenn Madill (1879-   ). Born in the Kawartha Lakes district of Ontario near Peterborough, Madill — after schooling at Lakefield — entered Queen's University, specializing in mathematics and physics. At the time of his graduation a federal civil service poster came to his attention. It advertised the position of Junior Magnetician, Dominion Observatory, at an annual salary of $1,620. A number of candidates applied for the post and examinations to test their abilities were compiled by Klotz. Madill, years later, recalled that of the three written tests, one paper proved easy for him, one on physics was mildly challenging, but that of the eight questions on the examination on terrestrial magnetism he felt capable of answering only the first four. Grimly resisting the temptation to feign more skill and knowledge than he possessed, Madill wrote frankly but somewhat despairingly on this paper, "Unfortunately for me, I know nothing about these last four questions." Years later the secretary to Dr. Klotz revealed to Madill that the director, in the case of each candidate, had looked only at the responses to the four most baffling questions. Following this scrutiny Klotz rang for his secretary and announced, "This man Madill gets the job. He's the one honest man among those who have written; the remainder are only bluffing!"

Dr. Klotz introduced young Madill to the man who would be his chief in the Terrestrial Magnetism Division, Charles A. French, remarking with a twinkle, "I expect you to teach Madill the ropes as he admits he knows nothing about the work here." Madill has recalled that Klotz, from time to time, would distribute to members of the observatory staff, details of a highly abstract mathematical problem, asking for solutions by an early deadline. To add to the stress Klotz would carefully remove all relevant reference books from the observatory library to his own office. Madill found in the course of these periodic tests that when he submitted solutions punctually these were received non-committally by the director. Accordingly Madill decided, on one such occasion, to pretend complete inability to solve the problem. Klotz brightened immediately. "Let me", he offered with obvious enthusiasm, "show you how it can be done."

Sometimes, in his office on an upper floor of the observatory, Madill would discover that certain half-solved mathematical problems left on top of his desk had been worked out by Klotz on week-ends. In climbing the stairs Klotz ignored strict orders from his doctor not to indulge in such activities. Gradually, and partly because of such efforts, the director's health began to fail. By December, 1923, he was confined to bed but on the fourth day of that month was able to take feeble notice of many congratulatory messages on the attainment by his wife Marie, and himself of their golden wedding anniversary. In his diary (now in the 57th year of its progress) Klotz, on December 6, mentioned C. A. French and assistant magnetician Madill "who is in the wilds adjoining the west coast of Hudson Bay. I have not heard from him for several months but he is due to reach civilization shortly".[2] His final diary note was entered on December 23. Otto Julius Klotz died late in the afternoon of December 28, 1923, in his home at 437 Albert Street, Ottawa. Headlines in the *Ottawa Citizen* of the following day announced "Canada Loses a Noted Scientist and Devoted Public Servant". An ambitious, forceful spirit, interested in promoting not only his scientific interests but the influence of the spoken and written word, Klotz was regarded in Ottawa as the "father of our public library". In his passing Canada lost the services of one of the most eminent seismologists in the Americas and an astronomer and surveyor of international distinction. On behalf of his beloved Canada he had taken an important and very active part in the completion of the first longitude girdle around the world in 1902.

It was during the Klotz period that the Dominion Astrophysical Observatory, with its 72-inch reflecting telescope, was formally opened at Victoria, British Columbia, on July 11, 1918. This telescope, for a brief time, was the world's largest. The giant glass disc, weighing 5,000 pounds, was cast and annealed at Charleroi, Belgium. The task was completed in July, 1914. The mirror was shipped from Antwerp only a week prior to the outbreak of the First World War. Had it not been shipped promptly to North America the mirror, in all probability, would have been destroyed by enemy action. The glass factory at Charleroi was reduced to ruins during military operations in its vicinity.

The Stewart Regime

At the turn of the present century the Astronomical Branch, Department of the Interior, was in its infancy and offered a challenging field for young Canadian scientists of promise. It was not a matter for surprise, then, that Robert Meldrum Stewart (1878-1954), one of the top mathematicians of his day in this country, should have joined the branch, his continuous service in the federal civil service dating from 1903. Stewart's high school training at Jarvis Collegiate, Toronto, and at Lisgar Collegiate, Ottawa, was marked by brilliant scholarship and the winning of nearly all available prizes. At the University of Toronto he graduated with high honors in mathematics and physics and was the university's gold medallist in 1902. As in the case of other Canadians of his generation who studied astronomy, Stewart came under the influence of Professor Chant's guiding spirit. The student's father had exerted an earlier beneficial influence and inspiration by taking his young son on long walks at night, explaining to him something of the movements of the stars and planets.

When Stewart joined the Ottawa organization the staff numbered only a few persons and occupied rooms near the Parliament Buildings. Observing of the heavens was done from a modest frame building on the south bank of the Ottawa River near the end of Cliff Street. In its early days the work of the Astronomical Branch dealt mainly with accurate longitude determinations, work of prime importance to the efficient prosecution of Dominion land surveys and in the construction of transcontinental railways in this country.

All accurate time, ascertained for the regulation of human activities, comes from the stars. In this process a telescope is trained on a selected star as it crosses the meridian in the heavens. This meridian is the north-south line that passes through the north pole of the sky and the point directly overhead, the zenith. The star selected is observed for a short period as it approaches the meridian, then the instrument is reversed and the star is again observed for an equal period after it leaves the meridian. By this procedure collimation errors are eliminated. In order to measure time effectively an astronomical event that repeats itself with perfect regularity and precision is required. The rotation of the earth on its axis is such an event and, in the ultimate analysis, is the measurer of all varieties of time — sidereal, solar, mean solar time and standard solar time. Sidereal time depends upon the position of the earth in reference to the meridian of the vernal equinox, a slowly changing point in the sky where the sun annually crosses the equator in the spring of the year.[3]

An international conference in Washington, D.C. in 1884, convened for the purpose of fixing a prime meridian on the earth's surface and the establishment of a universal day, resulted in the adoption of standard time throughout the world. The conference recommended that all nations adopt a single prime meridian in place of the then existing multiplicity of meridians governing time services, the zero meridian of longitude to be that which passes through the centre of the transit instrument at Greenwich Observatory, London. Prior to that conference, mainly through the efforts of Sandford Fleming, agreement was reached among the railway companies of Canada and the United States concerning the establishment of time zones. With the adoption of a prime meridian it was logical to divide the globe into 24 time zones, each covering 15 degrees of longitude. Canada has seven such time zones, with Yukon Standard Time nine hours behind Greenwich Mean Time.

One of Stewart's first functions with the branch and a task he attacked with great zeal was to inaugurate and develop a national time service. In 1904 a federal appropriation of $5,000 was made to provide for the installation of electric clocks in various government buildings in Ottawa. The clocks were to be serviced and controlled for accuracy by the new Dominion Astronomical Observatory. Stewart was appointed superintendent of the time service in 1905 and it was in this sphere of work and in positional astronomy that he made his most enduring scientific contributions. The first major improvement in the time service, which had its origin in the Ottawa observatory's longitude program, came with the acquisition by that institution of the 6-inch meridian circle telescope, a special type of transit used to determine positions of stars. Stewart supervised the installation of this instrument. The first extensive program at the observatory for fixing the accurate positions of stars was completed in 1923. Observations with the meridian circle telescope formed the basis for determination of accurate time until 1935. The availability of this service, particularly for the correction of the chronometers of field parties, marked an important advance in Canadian surveying.

When the longitude program was extended to stations in Canada lacking telegraphic communications Stewart devised the system of determining longitude by the use of wireless time signals. The first station occupied in this manner was at Quinze Dam, in Quebec province, in 1914. In 1923 the observatory discontinued longitude work in its relation to surveying but maintained its active interest in scientific aspects of the problem. Under Stewart's direction Canada participated in 1926, and again in 1933, in the establishment of longitude networks encircling the globe.

Demands began to mount for the distribution of accurate time to many parts of Canada. Time impulses had been sent by the observatory to local telegraph offices as early as 1905 but the first wireless transmission over local broadcasting stations did not occur until 1923. Four years later radio broadcasts of correct time began to emanate directly from the observatory through the use of short-wave facilities. It was then that Stewart conceived the idea of a time signal machine and supervised its construction, a task completed in 1938. Control of the workings of the instrument was provided by the governing Shortt pendulum clock. When a crystal clock was installed four years later it became the controlling apparatus. Service supplied by this machine included the noontime broadcast of correct time over the network of the Canadian Broadcasting Corporation, an announcement now familiar to listeners across Canada: "From Ottawa, the Dominion Observatory time signal — the beginning of the long dash, following ten seconds of silence, indicates exactly one p.m." Also provided were continuous short-wave time signals and the synchronization by direct wire of some 800 clocks in a score of federal government buildings in the nation's capital, the best known of which is the clock in the Peace Tower on Parliament Hill. Dominion Observatory time was declared by the federal government as the time to be used for official purposes throughout Canada.*

Among Canadian scientists prominent in the field of astronomy during Stewart's regime was William S. McClenahan (1892-1968), Ontario-born graduate of the University of Toronto in 1914, who joined the staff of the Dominion Observatory in Ottawa that same year. He served continuously, except for leave of absence during the First World War, until his retirement in 1957. At that time he was chief of the Positional Astronomy Division. McClenahan's contributions to science were many-sided. During his active career he made many thousands of transit observations. No other member of the Ottawa organization has been known to reverse the meridian circle instrument, as McClenahan did on one occasion, after a three-hour stint of observing and then continue on to obtain a second set of observations. The publication, following Stewart's regime, of three catalogues of thousands of stars observed from the Ottawa observatory was due to his efforts. During the greater part of McClenahan's service at Ottawa the pendulum performed as master timekeeper. He saw it replaced in 1957 by a quartz clock and also lived to witness the transition from these methods to an atomic standard of time and frequency.

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*O. in C. PC. 6784, Ottawa, August 28, 1941.

FIGURE 122. William S. McClenahan.

FIGURE 123. Malcolm M. Thomson.

Malcolm Macmillan Thomson (1908-) joined the Dominion Observatory staff, Ottawa, in 1930, following graduation in arts from the University of Manitoba in the previous year. His special interests in the tasks of the organization have included precise timekeeping and associated studies of variations in earth rotation and variation of latitude. Thomson was destined to become, first, acting head of the Positional Astronomy Division and, five years later, chief of the Astronomy Division. With the exception of three years in the Royal Canadian Air Force during the Second World War, Thomson's connection with the Ottawa observatory has been uninterrupted to date. Awarded a Master of Science degree from Yale University in 1954 Thomson later served a term as President of the Royal Astronomical Society of Canada.

Miriam Seymour Burland, born in St. Lambert, Quebec, graduate in arts at McGill University in 1926, joined the Dominion Observatory staff in Ottawa in the following year. Miss Burland, during her 40-year career as a scientist in that organization, specialized in meteor astronomy as well as along educational lines in making the observatory work better known to the public.

Charles Campbell Smith (1872-1940), born in Brampton, Ontario, came to the Dominion Observatory staff in Ottawa in 1905, following a period of service with the Topographical Survey of Canada as a draughtsman. In 1906 he was awarded his commission as a Dominion land surveyor. At the observatory he joined the Meridian Circle and Time Division (formerly Service), although the meridian circle transit instrument did not come into regular use in that division, as has been noted, until several years later. The untimely death of his wife in 1912 led to Smith's temporary and voluntary separation from the work of the observatory. For a number of years Smith practised land surveying in British Columbia, having been commissioned in that province in 1913.

Returning to the Meridian Circle and Time Division in 1919 Smith made a noteworthy contribution to the upbuilding of the organization. In 1924 he succeeded R. M. Stewart as division head. His participation in programs related to the establishment of the world longitude network was important to its success.[4]

As early as 1927 Smith prophesied the advent of computers, which happened some 40 years later, in the operations of the Dominion Observatory, Ottawa. "The greater ease, speed and accuracy", he wrote, "with which computations in a decimal system can be effected by machines soon impresses itself on any [human] computer . . . In these automatic machines . . . multiplication of 9 figures by 8 figures, or the division of 16 figures by 9 figures, takes 10 seconds. To carry out the multiplications and additions or subtractions in the example . . . for star reductions takes approximately one minute. This is at least three times as fast as it can be done by logarithms and the chance of error is very small."[5] Smith retired from the civil service in 1938, two years before his death.

When the Department of the Interior, as such, came to an end at the close of 1936, its organization under the title Department of Mines and Resources, brought about changes in the administrative structure of the observatory staff. In the process Stewart became the first director of the institution to be invested with the title *Dominion Astronomer.*[6] Special mention should be made here of several men whose scientific work at the observatory was linked with the Stewart regime. Ralph E. Delury, Assistant Director of the Dominion Observatory, Ottawa, for many years up to 1947, made a special study of sun spots as well as making many measurements of differential solar rotation. Judson Pulford Henderson contributed significantly to the development of uses of electronics at the observatory and accomplished much pioneer work on the functioning of radio sets on field surveys. Dr. Peter M. Millman, a gifted publicist and scientist on astronomical topics, became well-known nationally and internationally for his studies in the meteorite field at the observatory before moving to the National Research Council of Canada.

The year 1940 was one in which astronomical science and related studies in Canada suffered a number of grievous losses among its eminent personnel. In addition to C. C. Smith, J. B. Cannon, W. E. Harper and R. M. Motherwell, two former presidents of the Royal Astronomical Society of Canada passed away. One of these, Sir Robert Frederic Stupart (1857-1940) was born in Aurora, Ontario. While a student at Upper Canada College in Toronto he acted as a volunteer computer at the Magnetic Observatory located in that city and, at the age of fifteen years, became a member of its permanent staff. Stupart was noted for his work in meteorology and, in 1894, was appointed head of the Meteorological Service and the Toronto Magnetic Observatory. In 1902 he was elected president of the Royal Astronomical Society of Canada. He was knighted in 1916 for his services to science. Thirteen years later Sir Frederic retired from office.[7]

The second loss from the ranks of former Royal Astronomical Society of Canada presidents in 1940 was another Ontario-born man, Andrew Frederick Hunter (1863-1940). From 1904 to 1908 he had been associated with the Geological Survey of Canada.

John Beattie Cannon (1879-1940), born in Ottawa of Scottish stock, graduated in 1908 from the University of Toronto and joined the Dominion Observatory in the capital. After serving for eleven years on its staff he transferred to the Geodetic Survey of Canada and accomplished a great deal of important work in that organization.[8] Robert Millford Motherwell (1882-1940), Manitoba-born graduate of Perth high school in Ontario and of the University of Toronto, was married to Irene, daughter of Dr. W. F. King. After winning the gold medal of the Royal Astronomical Society of Canada in 1907 Motherwell was recruited for the observatory staff in Ottawa. He excelled in the photography of comets. Motherwell died in the year of his retirement from the civil service.[9]

For a number of years prior to 1940 there had been a steadily growing realization among professional astronomers in Canada of the need for some form of periodic recognition in order to foster interest in astronomy among laymen in this country. Accordingly, in that year, the Chant Silver Medal award was established, named after the then director of the David Dunlap Observatory. This award was to be presented annually to amateur astronomers on the basis of the value of work carried on in astronomy or in any of the closely allied fields of original investigation. The first winner of the medal was B. J. Topham in 1941.[10]

The loss to Canada and the world, by death, of R. M. Stewart was a heavy one. As a writer and lecturer on scientific subjects and as an administrator Stewart had won wide respect. Characteristically he was impatient with vague or inaccurate thinking but gave strong support to subordinates on his staff who could convince him of the value of their ideas. He enjoyed debating and was a gifted critic. Although Stewart was a man of strong feelings, these were normally concealed by the dignity and reserve of his manner. After 43 years with the observatory, nearly half of which he served as its director, Stewart retired in 1946. He died in Ottawa on September 2, 1954. Had he lived a few months longer he would have seen one of his fondest dreams transformed into reality, namely, the construction of an annex building to the observatory. Several times during his tenure of office plans had been formulated for such an extension to accommodate the expanding staff and to provide much-needed laboratory facilities.[11]

The Dominion Astrophysical Observatory

Progress in astronomy by the observatory staff in Ottawa, under Klotz and Stewart, was matched by achievements of the Dominion Astrophysical Observatory in Victoria. The official opening ceremony on June 11, 1918, marked the commencement of the third stage in the growth of Canadian astronomy. Harper had toured Canada searching for the site most suitable for observing the skies. Year-round stability of atmospheric conditions was a prime factor in making his choice. Harper, after much travelling and many careful surveys, selected property on the summit of Little Saanich Mountain. John Stanley Plaskett (1865-1941) was named first director of the observatory, and Harper joined its staff in 1919. Other assistants at the time were Dr. R. K. Young and the director's son, H. H. Plaskett. The total scientific staff numbered 38.

With the establishment of the new organization in Victoria and with the increasingly competent staff of the observatory in Ottawa, Canada at once assumed a prominent place in the international development of astronomy and in the general expansion of the physical sciences. The varied contributions made by these two major organizations of their kind illuminated many star problems and thrust telescopic explorations of our galaxy to new limits. Above all, these advances served to emphasize the basic role of astronomy in the surveying and mapping of a country. In fact it was to cope more effectively with the ever-growing need and demand for astronomically-fixed positions throughout this country, arising in part from the requirements of the Dominion lands surveys, the delineation of Canada's international boundaries, and from the need of coordinates for these and other surveys for cartographic purposes, that the two new Canadian observatories had come into existence during the first 20 years of the twentieth century.

The program of observations, initiated by J. S. Plaskett at Victoria in 1918, was mainly concentrated upon ascertaining the radial velocities of stars of miscellaneous spectral type for which the proper motions were known. This choice of program was a logical consequence of Dr. Plaskett's earlier work in Ottawa. With the aid of Dr. J. A. Pearce, who had joined the staff in Victoria in 1924, Plaskett made the first extensive observational test of the rotation of our galaxy. In fact this team of scientists was able to calculate the period of revolution and distance of the sun from the galactic centre. These results represented a remarkable forward step in man's acquisition of knowledge of the galactic system and formed a solid foundation on which many subsequent investigations have been based. One of the deepest satisfactions of J. S. Plaskett's life was the association he enjoyed with his son, H. H. Plaskett, in astronomical work, especially on the Victoria Observatory staff from 1920 to 1929.[12]

Dr. Harper, after his transfer in 1919 from the observatory in Ottawa to the new observatory in Victoria, served 21 years in all at the West Coast institution, succeeding Dr. Plaskett as director in 1936. Harper's contribution to astronomical science was substantial. His published scientific papers numbered more than 200 and he did much to popularize the study of astronomy in Canada by his writings, lectures and radio talks.

Another brilliant recruit to the staff at Victoria, a man destined to become Dominion Astronomer, was Scottish-born Robert Methven Petrie (1906-1966). As a university student Petrie worked at the Astrophysical Observatory in summer seasons from 1924 to 1929 inclusive. He joined the staff on a regular basis in 1935, specializing in spectral analysis of binary and multiple stars and in studies of our galaxy. During the period when he was a summer student Petrie began investigations of the motions of stars and of the nature of double and multiple stellar systems. It was in this field of effort that Petrie made his most distinguished contributions to science in subsequent years. Petrie also designed instruments for ascertaining displacements of spectral lines, a device that removed considerable drudgery from the measurement of radial velocities of stars. A few years before his death in 1966 Petrie, in association with Pearce, completed observations of the radial velocities of some 600 faint B-type stars, thus pushing the investigation of galactic motion farther into space than had ever been done before.[13]

In 1927 the staff of the Dominion Astrophysical Observatory was considerably strengthened by the arrival of Carlyle Smith Beals (1899-). Born in Canso, Nova Scotia, the son of Rev. F. H. Beals, he received his early schooling in Upper Canard in that province. At Acadia University young Beals specialized in physics and mathematics, graduating in 1919. After a period during which he taught in a one-room, all-grades, rural school, in order to finance his further education, Beals graduated with a Master of Arts degree from London University. In 1926 he returned to Acadia University as an associate professor of physics and, in the following year, joined the observatory staff in Victoria as assistant astronomer. Dr. Beals devoted much attention to the emission of line stars and also interstellar matter while he worked in Victoria. His thesis on the former subject won him a Doctor of Science degree from London University in 1934. During the years of the Second World War he made a special study of gases produced for use in warfare and worked out methods of defending against them. During this period also he designed a microphotometer that registered mechanically the form and total intensity of spectrum lines. In the course of the first 20 years of operation of the telescope at Victoria about 30,000 spectra had been obtained.

In 1946 Beals transferred to the Dominion Observatory at Ottawa, succeeding Stewart as Dominion Astronomer the following year. During his 17 years in that high office Beals guided the Observatories Branch, as it had come to be known, through a period of great expansion of its activities and facilities. This growth involved construction of the new geophysics laboratory, the establishment of ten new field stations across the country, and the extension of geophysical work to Arctic Canada. He directed as well the acquisition of modern astronomical equipment for time determination, solar studies, meteoric astronomy and general astrophysics. Beals engaged personally in studies of ancient meteorite craters in Canada, employing geophysical methods, and establishing an international reputation for his pioneering efforts in this, his second career.

In 1937 an addition of more than ordinary interest was made to the staff of the Victoria Observatory when the noted Dominion land surveyor, Guy H. Blanchet, was appointed as an assistant. Blanchet, who was also a British Columbia land surveyor, had first made known his interest in astronomy in a 1928 issue of the *Journal of the Royal Astronomical Society of Canada* in which he described his field observations of terrestrial magnetism and the aurora near Hudson Bay.[14]

The retirement of Dr. Plaskett in 1935 and that of R. M. Stewart about ten years later marked the end of the third stage in the development of Canadian astronomy. Both men had entered the service of the Dominion Astronomical Observatory in the same year, 1903. Each had headed their respective observatory staffs, as directors, for comparable periods and both had left favorable impressions of an indelible character upon their professional colleagues in Canada and abroad. In 1906 the number of stars whose radial velocities were known to astronomers of the world totalled 400, this information having been gathered, for the most part, by United States' observatories. From 1918 to 1935 that grand total had soared to about 7,000 of which more than 2,000 had been determined at Victoria. As in Ottawa, the Victoria institution had become a steady attraction to members of the general public. Visitors in 1934 totalled 21,608, close to the 27-year annual average, 1919 to 1935 inclusive.

Dr. Plaskett died in Esquimalt in 1941. Three memorial windows, installed as a tribute to Dr. Plaskett's character and works in St. John's Anglican Church in Victoria, are unique in that the gold melted from medals such as those awarded Plaskett by the Royal Society, the Royal Society of Canada, and the American Academy of Arts and Sciences realized a sum sufficient to cover the cost of the design and manufacture of these magnificent windows.[15]

Seismology

In the realm of geophysics the subjects of seismology, terrestrial magnetism, and gravity formed separate divisions of the original Dominion Astronomical Observatory organization and have continued as such to the present. Surveying and mapping activities have continued to play an important part in the progress of all three divisions. The creative interest and work of Klotz in seismology spurred the early growth of this field of study in Canada but from the close of his regime until 1952 the development of seismology in this country was largely the product of the successor to Klotz in this particular field, namely, Ernest Atkinson Hodgson (1886-   ).

In 1917 Hodgson's career at the Ottawa observatory hung precariously in the balance. At that time he was seismological assistant to Klotz but the low rate of pay attached to the position, along with an opportunity to take a teaching post in the Toronto Technical School that was more remunerative, convinced Hodgson that he should move to the Ontario capital. Klotz, however, was determined to keep him on his staff and made urgent representations to Deputy Minister W. W. Cory of the Department of the Interior in the hope of obtaining an increase in salary for his able assistant. In this effort Klotz was successful and the raise in Hodgson's annual pay from $1,600 to $1,800 helped the young scientist to change his mind and to remain with the observatory organization. This decision was noted jubilantly by Klotz in an entry in his diary on October 1, 1917.

In 1905 Klotz placed an order for two components of Bosch photographic seismographs and these were installed in January, 1906. The instruments had been acquired just in time to provide the first Canadian records of the San Francisco earthquake in April of that year. About this time each earthquake recorded by the observatory was given a number in a tabulation that has been carried on ever since. The time of each earth tremor, to within one second, has been entered in each instance and all records carefully filed and indexed. In March, 1912, a Wiechert vertical was obtained and this instrument continued to function well for many years.

Although written accounts exist of a severe earthquake in 1732 in the vicinity of Montreal where 300 houses were damaged and one life lost, the modern history of seismic disturbances in this country begins in 1897. In that year two Milne photographic seismographs were purchased, one for installation in Toronto and one in Victoria. The latter instrument registered 2,384 earth shocks, originating in various parts of the world, up to January, 1923. In that year the recorder was replaced by two Milne-Shaw seismographs. By 1926 seismological apparatus in Toronto was accommodated in a basement room of one of the student residences on the campus of the University of Toronto.

Earthquakes in Canada have occurred, for the most part, on the west coast and along the basins of the St. Lawrence and Ottawa rivers. As a result of instrumental recordings, the circulation of questionnaires, and personal investigations by members of the Ottawa observatory staff, a full report of the St. Lawrence Valley earthquake of February 28, 1925, was published. Following this study efforts were made by Dr. Hodgson to call to the attention of commercial interests in Quebec the need for including the earthquake factor in architectural planning in that province.[16] With the growth of Canadian cities and the construction of high office buildings and apartment complexes, the installation of water mains and lighting systems, the possibility of costly damage to these facilities from earth shocks greatly increased.

The 1925 earthquake also emphasized the importance of the role of the surveyor in relation to seismic disturbances. Lines of precise levelling run between Rivière-du-Loup and Lévis as early as 1915, and re-run soon after the earthquake by the Geodetic Survey of Canada, revealed an upwarping of the east end of the affected area in relation to the west end. This finding confirmed the field work of seismologists and gave validity to their deduction that the movement had occurred along a fault in the rock strata crossed by the St. Lawrence River and that the seaward side of the fault had snapped upward in relation to the landward side.

In the determination, with considerable accuracy, of the location of earthquake epicentres, geodetic surveyors could run branch lines of levels into the area and spread a triangulation net over it. Topographical surveyors could then prepare relief maps of the area. Geological surveyors could then examine the region fully. When any subsequent disturbance of the earth's crust occurred in this vicinity the surveyor would be in a position to reveal whether the crust had risen or fallen and also to disclose the direction of any horizontal shift.

By 1930 five seismological instruments were in operation at the Ottawa Observatory, namely, two Milne-Shaw and two Bosch horizontal instruments as well as one Spindler and Hager vertical. Sheets in these instruments were changed each morning. Each month the Dominion Astronomical Observatory issued a seismological bulletin. Seismological stations were established at Shawinigan Falls and Seven Falls in Quebec, as well as at Halifax and Saskatoon.[17]

A complete study was also made by federal seismologists of the Cornwall-Massena earthquake of September 5, 1944, a disturbance that caused property losses estimated at about $1,000,000. In the town of Cornwall more than 2,000 chimneys were damaged. On June 23, 1946, a quake occurred near the midway point along the east coast of Vancouver Island. Earth tremors, which continued for 30 seconds, wrecked chimneys and broke water mains in Victoria. This seismic shock proved to be one of the most severe of all Canadian earthquakes recorded in modern times and was clearly registered on seismograph instruments in the observatory in Ottawa.[18]

In December, 1951, after serving for several years as Assistant Dominion Astronomer, Dr. Hodgson retired from the public service. He was the last of the observatory staff to hold that title. At the same time he retired as chief of the Seismology Division, a post he had held for more than 30 years and in which he was succeeded by his son, Dr. John H. Hodgson. Beginning with the St. Lawrence earthquake of 1925 E. A. Hodgson carried out detailed field investigations of all major Canadian earthquakes. His 1925 survey was the most complete study of a non-disastrous earthquake made in the world up to that time. For many years he worked in close cooperation with Canadian mining companies in the application of seismic methods to mining problems. He was editor of the Bibliography of Seismology for nearly 30 years and, in 1938, was awarded the Gzowski Medal by the Engineering Institute of Canada. Many years previously he had won the Royal Astronomical Society of Canada Gold Medal. A prolific contributor to the pages of the *Journal of the Royal Astronomical Society of Canada,* Dr. Hodgson had a special facility for communicating with the general public, in his field of science, both by the written and spoken word. Dr. John Hodgson who became, in the course of time, Director of the Observatories Branch, carried on and extended Canadian seismological studies in the tradition so competently established by his dedicated and distinguished father.

Magnetic Surveys

Man has been intrigued, from the dawn of civilization, by the earth's magnetism. The Greeks were aware of the magnetic property of lodestone about 600 B.C., observing that it attracted small pieces of iron and that the same could be transmitted to the metal. But for many centuries they failed to recognize the direction-finding function of the stone. The name "magnet" may have been derived from the name of a place in the ancient world from which it could be obtained, Magnesia, in Asia Minor. In time the Greeks discovered that a suspended lodestone would come to rest in a definite position and that it possessed opposing poles.

The compass, by which practical use was made of the direction-finding ability of a magnet, became known to some Europeans as early as the 12th century. In this respect they lagged far behind the Chinese. Until the 15th century, in the western world, it was assumed that the compass needle pointed to the true, or geographic, north. The early charts of Mediterranean coasts were compiled from compass bearings. Apparent deviations from the north were at first attributed to mechanical imperfections in the construction of the instrument. Some historians credit Columbus with the discovery that declination or deviation was magnetic in origin. In any event, by 1500 it was known that the magnetic compass needle usually did not point true north but was deflected east or west by an angle, the extent of which depended upon the geographical location of the observer. The deviation from true north was described as the *variation* of the compass although magneticians in more recent times have preferred to use the term *declination*.[19]

The science of terrestrial magnetism may be said to have had its beginning in 1600 when the Englishman, William Gilbert (1544-1603) published his great work "De Magnete". Gilbert was the first to advance the concept that the earth itself possessed magnetic properties and that all magnets on its surface are influenced by its magnetic force. He concluded, wrongly, that its magnetic poles coincided with its geographic poles. But Gilbert's work served to dispel the theory previously held that the direction-finding power of the compass was due to some celestial attraction, such as the north star. Most of Gilbert's reasons for regarding the earth as a huge lodestone have been discarded long since but his work, nevertheless, laid the foundation for the development of geomagnetism as a science. By 1634 an English professor of mathematics, Henry Gellibrand, had demonstrated *secular variation* of the compass, that is, that its declination varied slowly in the course of time. This was an important finding because the compass had come into use not only as a navigational instrument but in surveying as well. From observations he made at Deptford, near London Bridge, Gellibrand noted that declination changed about seven degrees between 1580 and 1634. With this discovery land surveyors, who had been using the compass to define boundaries of private properties, could not retrace old surveyed lines without first ascertaining the change in magnetic declination that had occurred since the original survey.

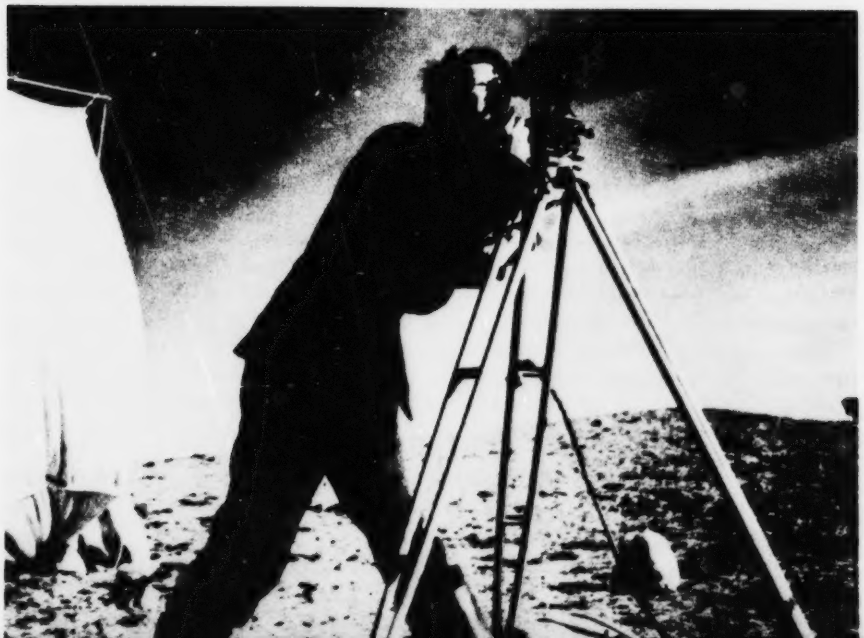
By the 1830s it had become obvious that a complete magnetic survey of the globe, involving the establishment of magnetic observatories in various localities, was imperative. A magnetic survey of the British Isles was carried out during the years 1836 to 1838. Subsequently Great Britain extended this type of survey to her territorial possessions abroad. In Canada the measuring of declination began with the earliest explorers. Magnetic observations were made at the site of Halifax by Samuel de Champlain in 1604. Similar observations began at Quebec in 1642 and at Montreal in 1700. Capt. James Cook made similar observations at Nootka as did Sir John Franklin during his Arctic voyages. Because the compass became indispensable to navigation and the expansion of world trade, charts of ocean areas soon came into existence, portraying the degrees of magnetic declination in various zones. In 1701 a chart was published depicting lines of equal declination traversing the Atlantic Ocean. Maps of land areas were issued later, serving the same purpose as the ocean charts. Such maps are now published at frequent intervals.

Reference has been made previously in "Men and Meridians" to the extensive magnetic surveys made in western Canada by Lefroy from 1842 to 1844. In 1880 the Topographical Survey Branch, Department of the Interior, began to assemble data on magnetic declination as observed at numerous stations across the country. The magnetic division of the Dominion Observatory, Ottawa, formed to promote systematic studies of the electromagnetic force of the earth as applied to Canada, came into existence in 1907. In the field seasons of 1922 and 1923 magnetic data were collected along the Mackenzie, Peace, Athabasca, and Slave rivers as well as in northern Saskatchewan and Manitoba. In the latter province the area covered was from the western boundary to the west coast of Hudson Bay and between The Pas and the 60th parallel of latitude. At each magnetic station established in the course of these surveys the declination was measured, the magnetic meridian determined as well as the astronomic meridian and the angle between the two, giving the extent of declination. The dip or inclination to the earth's magnetic field was measured in the field either by a dip circle or by an earth inductor.

The location and development of deposits of magnetic ore and other investigations by geologists are aided by a knowledge of the behavior of the earth's magnetism and by the use of instruments for measuring it. By 1928 keen interest was being shown in Canada in the use of magnetic methods of surveying mineral claims. Some of the methods employed depended entirely on the effects of the magnetic field of the earth and on natural currents of electricity beneath the surface.

Under directors French and Madill the work of the magnetic division had grown in recognition and importance. By 1947 it was operating four magnetic observatories, namely, at Agincourt, Ontario, and Meanook, Alberta, and two in the Arctic. The Ontario institution was formerly the Toronto Magnetic Observatory, moved to Agincourt in 1898. These observatories have become part of an international network and the results of their Canadian studies are used in world-wide discussions on the nature and effects of the earth's magnetism. By 1947 also the division had established 1,300 field stations in a system extending from Cape Race, Newfoundland, to Triangle Island, British Columbia, and from Canada's southern boundary to the northern tip of Ellesmere Island. At a number of these stations repeated observations are made to ascertain changes in the direction and magnitude of the earth's magnetic field. The division also keeps track of the wanderings of the rather mobile north magnetic pole.[20]

FIGURE 124. Magnetometer in use in the field.



When many observations of this type are made across the nation a magnetic chart is the most convenient method of representing general conditions for any particular period. Isolines shown on such charts are analogous to contours on topographic maps.

Gravity Surveys

Among the most interesting scientific problems concerning the nature of our earth are those related to the direction and intensity of this planet's gravitational force. Galileo, whose experiments demonstrated that heavy objects do not fall faster than light ones, laid the groundwork of the science of mechanics. This science, in turn, led to Newton's law of universal gravitation and his laws of motion. The acceleration of gravity, like the velocity of light, is one of the earth's most important fundamental quantities in physics. In 1902, under the supervision of Dr. Klotz, the Ottawa observatory initiated pendulum measurements of gravity as a contribution to international studies to determine the shape of the earth and to test the theory of isostasy as applied to North America. For somewhat more than 40 years such measurements, totalling about 200, were made throughout Canada. After the Second World War the pendulum was replaced for these purposes by the gravimeter.

Initially in Canada official interest in geophysics lay in its application to the larger problems of the nature of the earth. Soon, however, it became obvious that the earth sciences held interesting possibilities for expediting searches for mineral wealth. Accordingly, in 1928 and during succeeding years, Andrew Howard Miller (1886-1962), then chief of the gravity division, Dominion Astronomical Observatory, carried out original investigations, in cooperation with the Geological Survey of Canada, into basic practical aspects of gravitational and magnetic methods of prospecting for minerals.[21]

A. H. "Joe" Miller, widely recognized as a pioneer of Canadian geophysics, was born in Manitoba and received his elementary and secondary education in Winnipeg. He was awarded a degree in mathematics and was named a Rhodes Scholar from Manitoba. He graduated from Oxford University as a Bachelor of Arts in 1910 and as a Master of Arts in 1919. In the intervening years he lectured at the University of Wisconsin after which he served with Canadian forces in France during the First World War. On returning to Canada in 1920 Miller joined the Dominion Observatory in Ottawa and remained on its staff until his retirement in 1951.

Miller was mainly responsible for the initiation of systematic gravity surveys in this country. The early surveys carried out by him testify to his scientific ingenuity and physical endurance. Travelling in the Canadian wilderness by barge, wagon train, pack horse, and on foot, while transporting more than two tons of equipment and provisions, Miller made two memorable trips to the lower reaches of the Mackenzie River during the field seasons of 1921 and 1922. En route he made pendulum observations and established gravity values at points considerably north of the Arctic Circle. On these ventures Miller provided the first significant information concerning the variation of gravity with latitude in Canada.

Throughout the 1920s Miller concentrated on isostasy studies. By careful observation and by prodigious mathematical industry he demonstrated that the large part of Canada covered by his measurements was in a condition of isostatic equilibrium. Thereafter Miller became interested in what were, at the time, revolutionary methods of applying physics to problems of structural geology and to prospecting for minerals.

During the Second World War he put to use his skill and knowledge in the promotion of Canada's war effort. For three years he assisted at the National Research Council of Canada in the establishment and maintenance of a standard gauge-testing laboratory for use by war industries of this country.[22]

In 1922 the first torsion balance instruments were brought to Canada by the Dominion Observatory, Ottawa. The torsion balance was a remarkably sensitive device capable of measuring the gradient of gravity in a horizontal direction. Because of some defects in its manufacture initial use of the instrument in this country was not made until seven years later. By 1928 general interest in geophysical methods of prospecting had been aroused across Canada, mainly as a result of the introduction of electronic methods of detecting sulphide orebodies.[23] The torsion balance, for example, was used in a gravity survey in 1934 of the Malagash salt deposit in Nova Scotia. The resulting gravity map outlined the area in which a deficiency of mass occurred owing to the presence of salt. The precise dimensions of the deposit were not known until this survey was completed. Tests carried out in 1947 by the Dominion Observatory over mines in western Quebec proved that gravity measurements could be made of surface orebodies, even when completely covered by overburden. The orebody was clearly outlined by the gravity contours.

Between 1944 and 1955 reconnaissance surveys with periodic gravity measurements were carried out through southern Canada by automobile, and in northern Canada by light aircraft. During this period some 10,000 regional measurements were obtained, providing data for the first edition of the Gravity Map of Canada, 1956.

Miller's retirement occurred in the middle of this transitional period. He was succeeded as chief of the gravity division by Dr. Morris J. S. Innes, graduate of the University of Saskatchewan and the University of Toronto. The final phase of Miller's scientific career was associated with a radical change in both the speed and accuracy of gravity measurement through the use of highly portable gravimeters. These new instruments, which revolutionized gravity studies throughout the world, became generally available after the end of the Second World War. Miller was quick to realize their advantages and concentrated on the development and standardizing of field procedures involving the use of gravimeters. In field seasons from 1945 to 1951 he established by his personal efforts some 5,000 gravimeter stations along the highways of southern Canada from the Atlantic Ocean to the Rocky Mountains.

Miller won international recognition for his investigations of isostasy and for his work in establishing gravity ties between national reference stations for gravity in Europe and North America. His output of some 30 scientific papers form an enduring contribution to the knowledge of earth physics.

The David Dunlap Observatory

In May, 1921, three years after the opening of the major observatory in Victoria, a casual incident occurred at a public lecture in Toronto, a happening that had an important bearing on the future development of Canadian astronomy. In the audience being addressed by Professor Clarence Augustus Chant on the topic of Winnecke's Comet, was David Alexander Dunlap (1863-1924), a Vice-President and Treasurer of the Hollinger Consolidated Gold Mining Company, Limited. After the lecture Dunlap made himself and his keen interest in astronomy known to the professor. They became

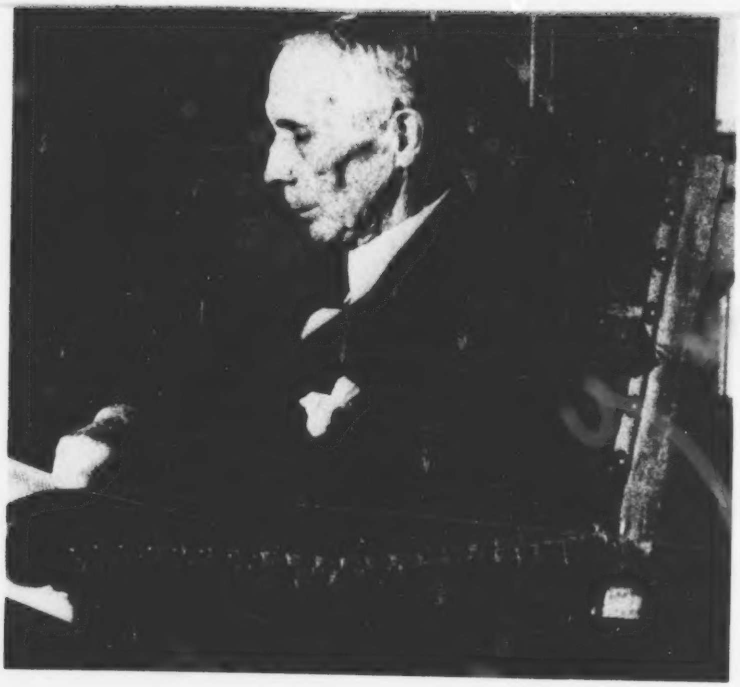


FIGURE 125. Dr. C. A. Chant.

fast friends and, later in that same year, Dunlap was elected to membership in the Royal Astronomical Society of Canada. It was this initial meeting of Chant and Dunlap that led to the erection, 14 years later, of the important observatory at Richmond Hill, north of Toronto, on the 70th birthday anniversary of its most earnest and persistent advocate, Dr. Chant.[24]

Dunlap's death in 1924 was a heavy blow to Chant but, fortunately for the future of Canadian astronomy, Mrs. Dunlap revealed her own deep interest in the subject and in Chant's long-cherished dream of the creation of a major observatory connected with the University of Toronto. Accordingly she authorized Dr. Chant to proceed with plans for the construction and operation of such an observatory near Toronto. Years later, at the formal opening of the observatory building Chant told how the Richmond Hill site was selected. "My colleague, Dr. R. K. Young, and I would study a large-scale contour map of the country within fifty miles of Toronto and would then explore the places we had selected. When we found a possible site Mrs. Dunlap would inspect it. Well do I remember driving up yonder lane on a sunny afternoon in June, 1928, and parking the car near the old barn, clambering through a barbed-wire fence and, walking to the top of the hill. 'This is the site', she said."[25]

At the largely-attended opening ceremony on May 31, 1935, Mrs. Dunlap formally presented the University of Toronto with the splendid new observatory, housing a 74-inch telescope, the mirror of which had been cast in Corning, New York. This was the second largest telescope in the world at the time. Many dignitaries were present, including Prime Minister Mackenzie King. A number of honorary degrees were awarded on the occasion, including doctorates to C. A. Chant and W. E. Harper. In his remarks Dr. Harper stressed the importance of the application of astronomy to the tasks of precise surveying.

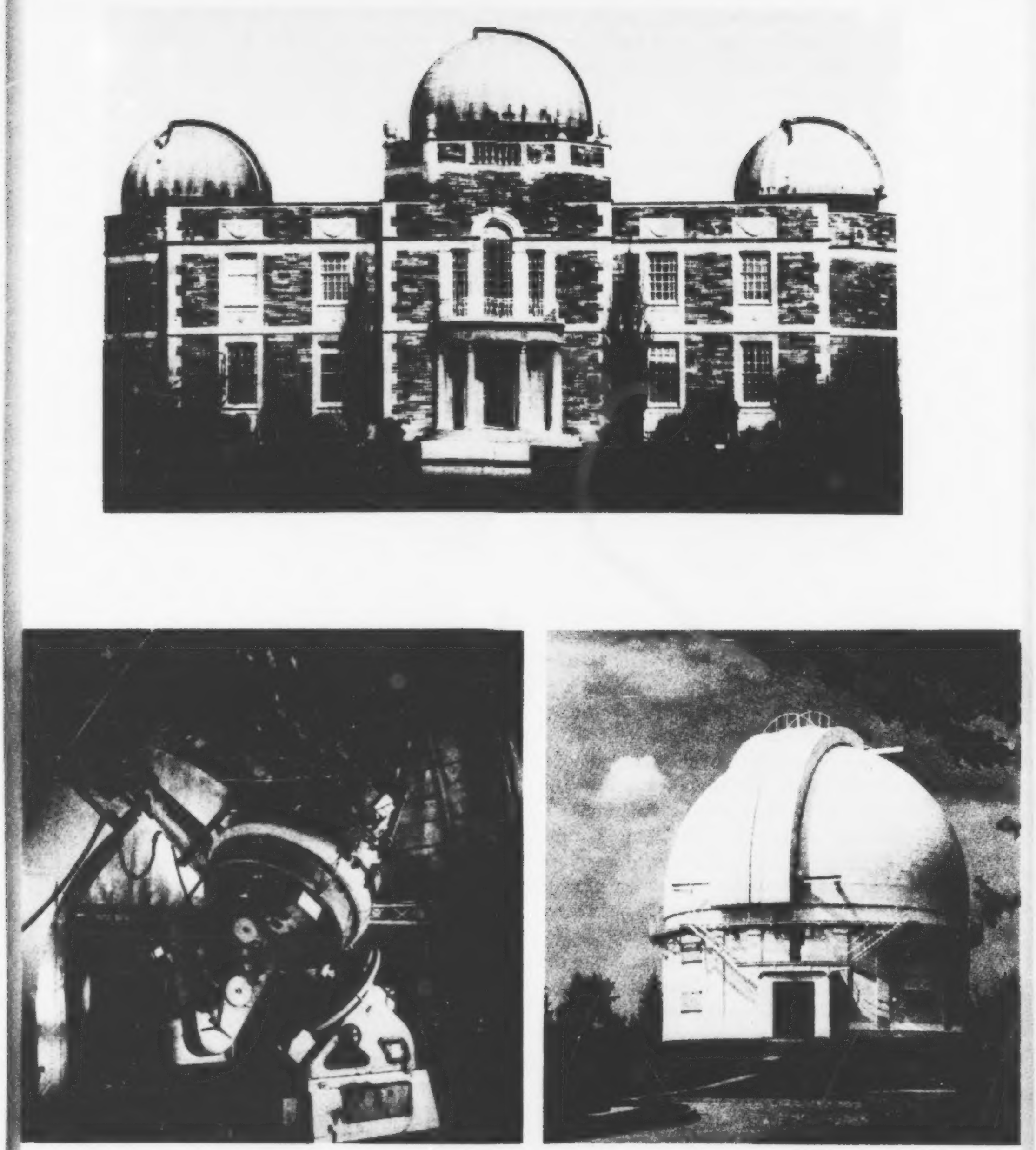


FIGURE 126. David Dunlap Observatory, Richmond Hill, Ontario.

Dr. Young had earlier in the ceremonial proceedings made reference to planned improvements to the observatory grounds. "It is intended to make the [surrounding] land into a park to be known as the David Dunlap Park, and it is very desirable to plant trees over the area as soon as possible. The reason for having the ground covered with a growth of trees is to shield it from the sun on warm days. On an open plain the ground becomes quite hot during the day; and when, at sunset, this heat is given off again, the warm air flowing upwards creates an unsteady atmosphere which interferes with the use of the telescope."[26]

The David Dunlap Observatory was also a monument to the ambitious and persevering efforts of Dr. Chant over many years. He graduated in mathematics and physics at the University of Toronto in 1890 and in the following year was appointed to the university teaching staff in the department of physics. He taught continuously until his retirement in 1935, a period of 45 years that constituted a momentous period in the history of Canadian astronomy. In 1904 a sub-department of astrophysics was formed under his leadership and a graduate course in astronomy was added to the curriculum. From this point on, and for nearly half a century, Chant's overriding purpose in life was to promote the study of astronomy. In his career he had trained most of Canada's astronomers of the period, among them five men who became directors of important Canadian observatories. As early as 1912 he began a campaign for the acquisition by the university of a large telescope to facilitate major research in the science.

One of the foremost astronomers in Canada in the period under review in this book, and who became a member of the staff of David Dunlap Observatory, is Dr. Helen Sawyer Hogg, whose wide-ranging mind has been engaged in a number of branches of the science and who is particularly well-known for her studies of globular star clusters. Born and educated in Massachusetts, Mrs. Hogg graduated from Radcliffe College, now part of Harvard University. There she met Frank S. Hogg. They were married and she came with him to Canada. He served as director of the David Dunlap Observatory from 1946 until his death in 1950.

Dr. Chant wrote several books, including *Our Wonderful Universe*, a classic yet simple exposition of basic astronomy. For fifty years he served as editor of the *Journal of the Royal Astronomical Society of Canada*. In research his wide interests ranged from early experiments with Hertzian waves to the Einstein Effect at total solar eclipses. His activity in the latter field took him, along with his colleague Dr. Young, to Australia in 1922 where they obtained early verification of the Einstein theory of gravitation, through the observed deflection of starlight by the mass of the sun.[27]

On November 18, 1956, at the age of 91, Dr. Chant died at Observatory House, Richmond Hill. The example of his devoted efforts over the years in the realm of astronomy inspired the construction of a number of non-government Canadian observatories in the 1940s. Although these institutions are considerably smaller than the Richmond Hill Observatory they continue to contribute helpfully to the general advancement of astronomy in this country. The Hume Cronyn Observatory was formally opened at the University of Western Ontario in London on October 25, 1940; the Ville Marie Observatory opened in Montreal in 1941; the University of Alberta Observatory opened in Edmonton in 1943; the Quebec City Observatory in 1944 and, shortly after, the Oak Bay Observatory began operations in Victoria.

The Royal Astronomical Society of Canada

In 1890 the Astronomical and Physical Society of Toronto, originally known as the Toronto Astronomical Club (1868) was incorporated. Thirteen years later its name was changed to the Royal Astronomical Society of Canada, complete with constitution and a motto *"Quo ducit Urania* — Whither thou leadest, Goddess of the Heavens." The purpose of the organization was "to study astronomy and astrophysics and such cognate subjects . . ." The Society was federalized through a constitutional provision for the creation of branches or centres from coast to coast. In addition to the unit in Toronto other centres were established in subsequent years in all of Canada's principal cities, although not all of these centres of the Society have survived. The organization's Gold Medal and Chant Silver Medal awards have helped to stimulate the spirit of enterprise and research among professional and amateur astronomers throughout Canada.

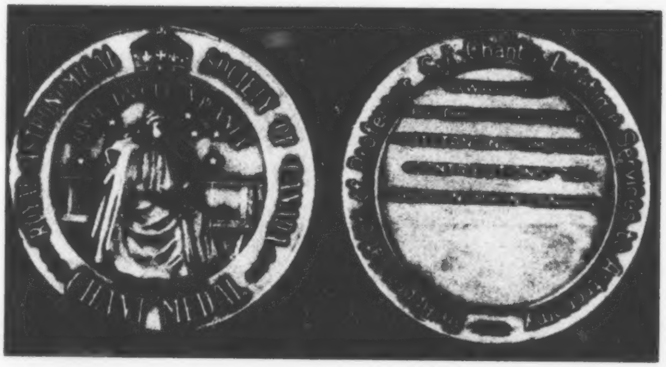


FIGURE 127
Chant Silver Medal.

From the time of the observations of stars made by early French explorers of the 17th century practical applications of astronomy have held the attention and inspired the investigations of many Canadians. But progress in the science has been generally slow and uneven in this country until relatively recent times. Probably the most noteworthy work in surveying and mapping the heavens from anywhere on the northern half of North America was accomplished by Canada's first Surveyor General, Samuel Holland. During his years in office, 1764 to 1801, Holland contributed four papers on astronomy to the Royal Society in England. The first of these described his observations from the islands of St. John (Prince Edward Island) and Cape Breton in order to ascertain the latitudes and longitudes of those places. The second concerned astronomical observations made in 1769. The third paper related to eclipses of Jupiter's satellites as observed near Quebec City in 1774, and the fourth described Holland's astronomical observations in Canada in 1774.[28]

Despite the giant forward strides taken by this country in the realm of astronomy during the Stewart-Plaskett period, the war years with their aftermath of unsettlement brought about a steady decline in Canada's international standing in this area of science.

In telescopic power, for instance, Canada fell from second to eleventh place among the nations between 1935 and 1965. During that 30-year span, during which general interest in studies of the universe greatly increased, no large telescope was established in this country. In the mid-1960s, however, the Dominion Radio Astrophysical Observatory began to function near Penticton, British Columbia, with a research program designed to promote a survey of galactic background radiation as well as the measurement of intensities of brighter radio sources in our galactic system.

Under a plan now pending the federal government has agreed to turn over to a corporate entity composed of a group of western Canadian universities, certain assets already developed for the Mount Kobau (B.C.) telescope project. This consortium consists of three universities in Alberta and three in British Columbia. Cooperation with those institutions of a team of experts from the Dominion Astrophysical Observatory forms one of the important assets involved in this arrangement. The telescope, the mirror of which measures 157 inches in diameter, when erected will be one of the most powerful in the world.

GLOSSARY

Astronomy: the science dealing with celestial bodies, especially their positions, magnitudes, motions, mutual relations and distances.

Astrophysics: a branch of astronomy dealing mainly with the physical and chemical nature of celestial bodies as well as their origin and evolution.

Binary Stars: a form of double star in which the two members are relatively near to each other and revolve around a common centre of gravity.

Epicentre: a point from which earthquake waves seem to radiate, and situated directly above the true centre of disturbance.

Fifteen-inch Equatorial: a type of viewing telescope with object glass measuring 15 inches across, and the main axis of which is parallel to the axis of earth.

Galaxy: our galaxy is the Milky Way. Similar formations are to be found in great numbers beyond our Milky Way and are referred to as external galaxies.

Geophysics: the science dealing with the relationships between the features of the earth and the agencies that produce them.

Gravimeter: a sensitive spring balance instrument that measures changes in the earth's gravity as small as two parts in 100,000,000.

Isostasy: the equilibrium of the earth's crust, a condition in forces tending to elevate, balance those tending to depress.

Photographic Photometry: the measurement of the luminosity of stars from their images on photographic plates.

Radial Velocity: velocity of a star directly in the line of sight as it recedes from, or approaches, the observer who is in a fixed position.

Sidereal: pertaining to, or as determined by, the stars. Sidereal time, for example, is time measured by the apparent daily motion of the stars.

Spectrum Lines: the distinctive lines that appear in the rainbow-like pattern produced when a light source is passed through a prism or reflected from a grating. These lines identify the chemical composition of the source of light, such as a star.

14

THEMATIC MAPS IN CANADA

> *"No study is realistic that treats humanity as if it lived suspended in empty space instead of treading a world of minerals, forests, climates and soils."*
>
> —Isaiah Bowman

Topographical maps, particularly large-scale representations, may be said to depict conventionalized landscape within the constraints of a general system of cartographic techniques. They show the location of things that most people can recognize at sight. There is, however, another major class of maps which are not devoted essentially to the depiction of landscape but which serve to analyze total environment. Until fairly recent times these cartographic productions were known by various terms such as topical, economic, subject, or special-purpose maps or, in the military sphere, as intelligence maps. The term *thematic* is now frequently applied to describe maps of this classification.[1] Thematic maps portray the distribution and characteristics of classes of things which may appear on topographical maps, usually one subject to one thematic map and in addition, deal with many specific environmental factors, such as climate, not directly expressed on any topographical map. For these special purposes thematic maps employ cartographical techniques bearing only an incidental similarity to those used in producing topographical maps. Only a relatively small proportion of thematic maps are made available for direct distribution to the public in separate sheet form. The audience reached by such maps through the medium of atlases is, however, very large.[2]

It should be borne in mind that in the cartographic domain the distinction between maps that are thematic and those that are topographical has not yet been rigorously defined. Many of these special-purpose maps require general outlines of land areas or contoured bases depicting drainage features or elevations, either in simple or complex form. The thematic map, in presenting special information, may utilize topography as a component without emphasizing it.

Thematic maps are used to complement statistical information. The production of thematic maps involves the possession and use of intimate knowledge of the specific topic as well as of the supporting data being used to illustrate that topic in cartographic form. Thematic maps, generally, are of the small-scale variety. Types of diagrams employed to portray specific themes include line, track, or arrow symbols of the sort featured in flow maps to indicate the direction of traffic or trade; histograms, horizontal bars, and pie graphs to provide a comparison of differing sizes, illustrating the scope of a subject in its totality; or the use of sectors of circles to denote proportions of component parts of the whole.[3] The range of symbolization is, in fact, unlimited.

Discussion of thematic maps may be approached by considering the types of distributions and phenomena with which thematic maps deal. The types of distribution may be classified as follows: (a) distribution occurring at points (places) but not between points as, for example, the population of a city or the production of an oil well; (b) distribution along lines but not between lines, such as the volume of flow of a river or volume of traffic flow along a railway; (c) distribution continuous across an area as, for example, atmospheric pressure at the surface of the earth or the extent of population within a settled area larger than a single community.

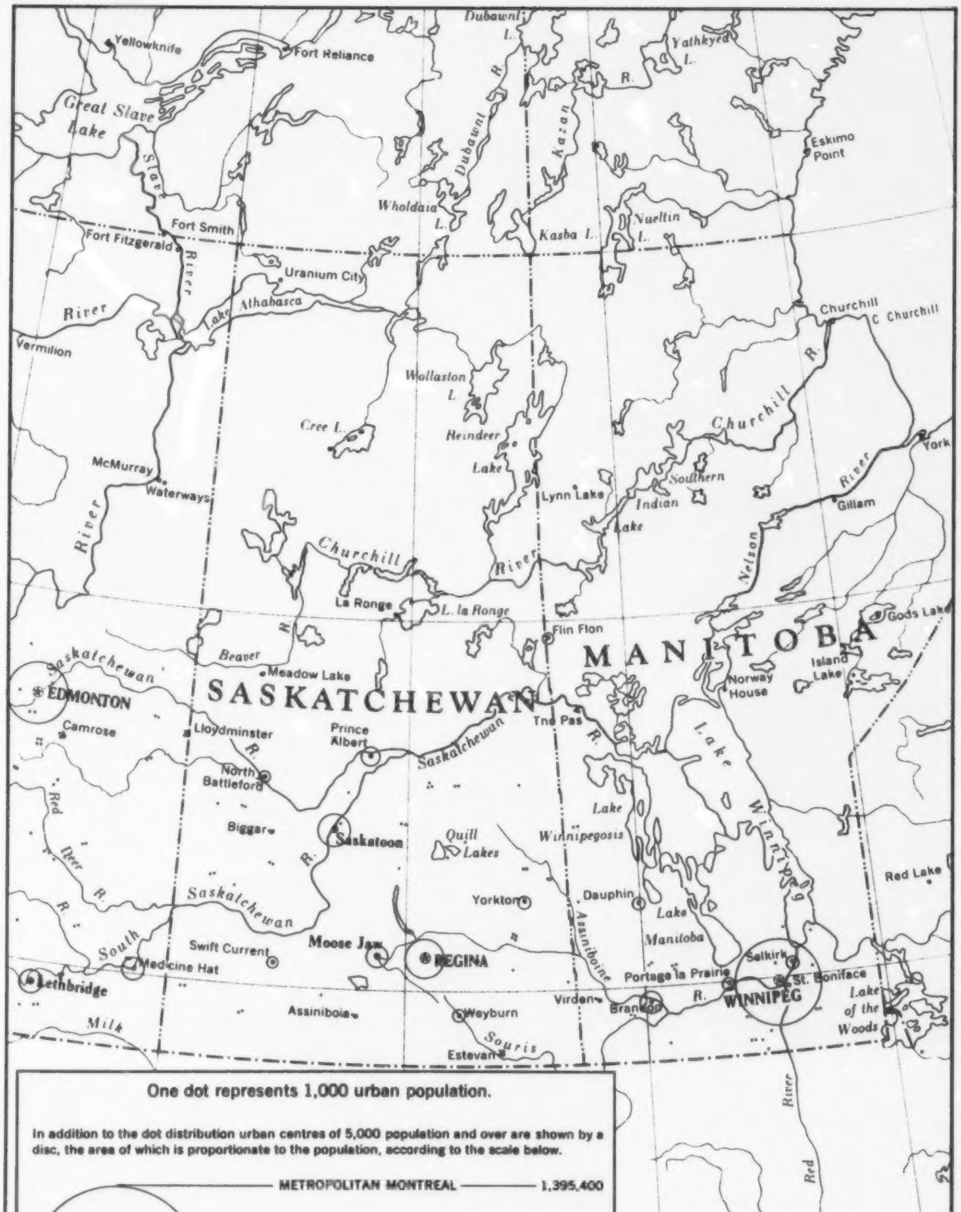
Some kinds of phenomena may be expressed as qualitative types, such as soil or forest classifications. Each type is assigned a color and the resulting map is a composition of area colors. Maps of this kind are sometimes described as *chorochromatic*. In the cartographical expression of quantitative data, such as population distribution or industrial production, the symoblism used is rather diversified and relatively complex. A description of various techniques used in the presentation of such data are considered under the three main headings already mentioned.

(a) Distribution at points but not between points

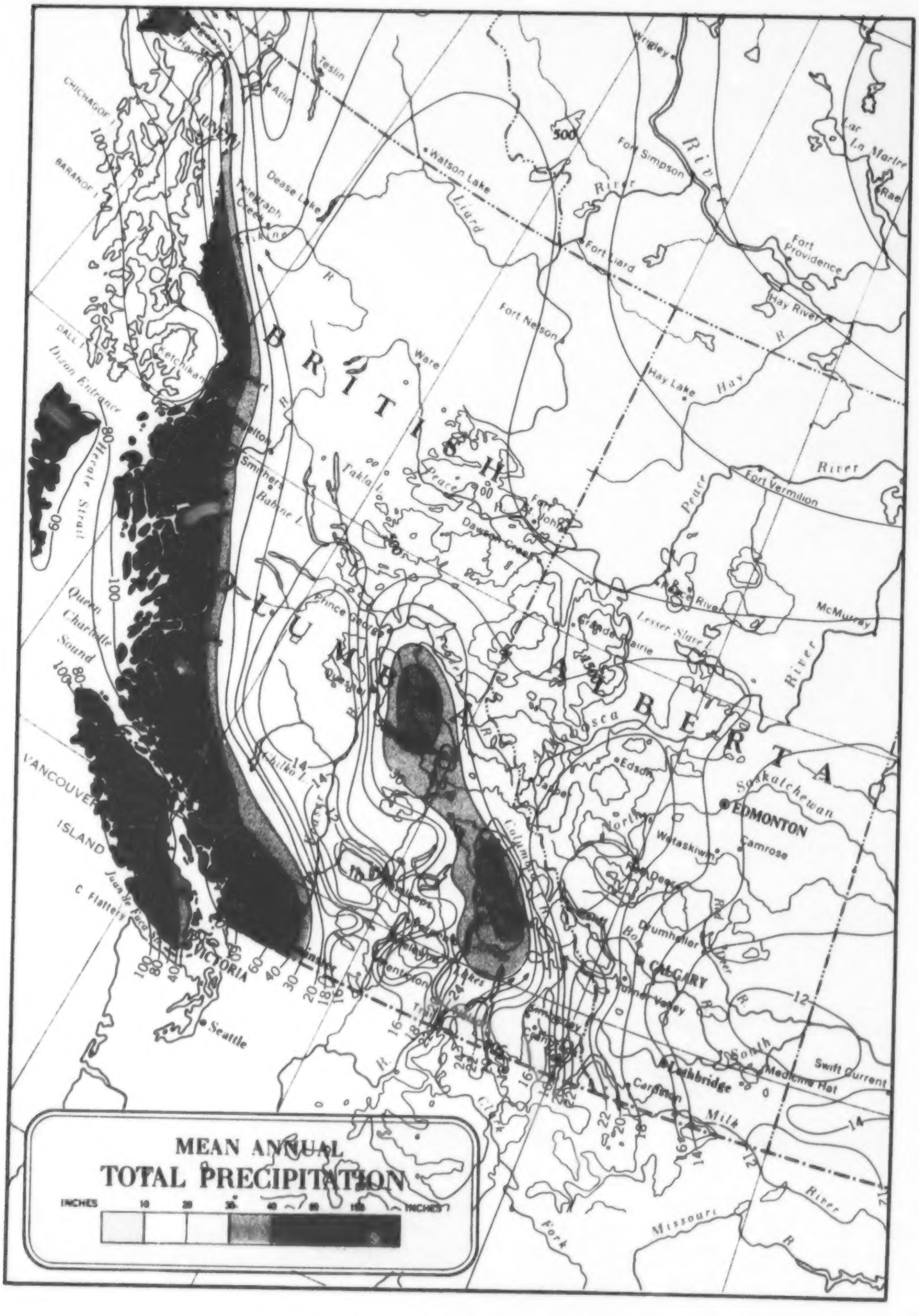
The object of thematic mapping in this category as, for example, portrayal of the population of a city, is to express the quantities by graphic methods. This is done by assigning quantitative values to symbols and by placing these in their correct location. Symbols may be different in shape, size, color or internal design or there may be a combination of some or of all of these characteristics. Any point symbol expressing quantity may be described as a volumetric point symbol. Any plane or solid geometrical form may be used for the purpose. These are of three main types: proportional circles or proportional squares in which the quantity expressed is in proportion to the area of the circle or square; secondly, proportional spheres in which shading is used to give the impression of a sphere; thirdly, proportional cubes in which line work or shading is used to create the impression of a cube. In the cases of cubes and spheres the depicted volume of the symbol is in proportion to the quantitative value of the phenomenon under consideration.

(b) Distribution of quantities along lines but not between lines

The method of expressing quantitative phenomena of this nature is basically similar to that used in depicting values that occur at points or places. The values along the line may be expressed by color of line, type of line, e.g., by a broken line, or by width of line where the width is proportional to the value along the line. These symbols are commonly known as flow lines.


Yellowknife
Fort Reliance
Dubawnt L.
Yathkyed L.
Great Slave Lake
Slave River
Dubawnt R.
Kazan R.
R.
Eskimo Point
Wholdaia L.
Kasba L.
Nueltin L.
Fort Smith
Fort Fitzgerald
Uranium City
Lake Athabasca
River
Vermilion
Churchill
C Churchill
Wollaston L.
Churchill R.
Cree L.
Reindeer Lake
York
McMurray
Waterways
River
Lynn Lake
Southern Indian Lake
Nelson River
Gillam
Churchill River
La Ronge
L. la Ronge
Gods Lake
Flin Flon
MANITOBA
Saskatchewan
Beaver R.
Meadow Lake
EDMONTON
SASKATCHEWAN
Norway House
Island Lake
Camrose
Lloydminster
Prince Albert
The Pas
Saskatchewan R.
North Battleford
Red Deer R.
Lake Winnipegosis
Lake Winnipeg
Biggar
Saskatoon
Quill Lakes
Red Lake
Saskatchewan R.
Yorkton
Dauphin
Lake Manitoba
Assiniboine R.
South
Swift Current
Moose Jaw
REGINA
Selkirk
Medicine Hat
St. Boniface
Lethbridge
Portage la Prairie
WINNIPEG
Lake of the Woods
Milk
Virden
Brandon
Assiniboia
Weyburn
Souris
Estevan
Red River
Missouri
James
R
One dot represents 1,000 urban population.
In addition to the dot distribution urban centres of 5,000 population and over are shown by a disc, the area of which is proportionate to the population, according to the scale below.
METROPOLITAN MONTREAL — 1,395,400
METROPOLITAN VANCOUVER — 530,728
METROPOLITAN EDMONTON — 173,075
METROPOLITAN ST. JOHN'S — 67,749
SAULT STE. MARIE — 32,452
YARMOUTH — 8,106

MAP 5. Example of use of volumetric symbols, Atlas of Canada, 1957.


MEAN ANNUAL
TOTAL PRECIPITATION
INCHES
10
20
30
40
60
100
INCHES
BRITISH COLUMBIA
ALBERTA
VANCOUVER ISLAND
Queen Charlotte Sound
Hecate Strait
Dixon Entrance
CHICHAGOF I.
BARANOF I.
Juneau
Atlin
Teslin
Telegraph Creek
Dease Lake
Watson Lake
Liard
Fort Simpson
Fort Liard
Fort Providence
Hay River
Fort Nelson
Ware
Hay Lake
Fort Vermilion
Ketchikan
Smithers
Babine L.
Takla L.
Peace
Fort St. John
Dawson Creek
Prince George
Grande Prairie
Lesser Slave L.
McMurray
Athabasca
Jasper
Edson
EDMONTON
Camrose
Wetaskiwin
Red Deer
Drumheller
CALGARY
Turner Valley
Lethbridge
Cardston
Medicine Hat
Swift Current
Milk
South
Missouri
Fork
Chilko L.
Kamloops
Penticton
Trail
Nelson
Okanagan
Columbia
Saskatchewan
Fraser
VICTORIA
Juan de Fuca Str.
C. Flattery
Seattle
Wrigley
Lac la Martre
Rae
500
100
80
60
40
30
20
18
16
14
12

MAP 6. Example of use of isarithms, Atlas of Canada, 1957.

(c) Distribution continuous across an area

Cartographical methods employed in this category may be classified in three main types:

1. The statistical surface, for instance, an atmospheric pressure or weather map. The compilation of a statistical surface begins with a distribution of numbers on a base map. Each number represents a measurement, or value otherwise derived, applied to a particular location. Thereupon the locations of equal values with a prescribed value-interval is determined and the points of equal value joined by lines generally known as *isarithms*. A contour line joining points of equal elevation is one example of an isarithm.

2. Choropleths. For some types of phenomena, construed as being continuous across an area, measurements or values are available not at points but only for delineated areas. In order to map this type of distribution of values, colors are designated as representing particular values or ranges of values. The resulting map is a composite of area-colors showing the distribution of values by areas. This type of quantitative area-symbol is called a *choropleth*.

3. Dots. The use of dots in thematic maps offers an alternative to the use of choropleths. Let us take, for example, a map showing population. A dot, let us say, is assigned a value of 10 units. If a value of 100 has been assigned to a delineated area then 10 dots would be entered in that area. If only part of a census division happens to be settled, population dots would be confined to the settled area within the census division, thereby providing a more accurate picture of the distribution of people than is possible by use of the choropleth method which applies to the entire census division. Dots also may convey a visual impression of relative densities not afforded by choropleth colors.

The preparation of such maps constitutes a task for specialists working in close cooperation with cartographers. The former provide knowledge of the purpose and use of maps as policy guides and as research tools; the latter provide skills in the techniques of graphic presentation.[4]

(d) Other types of symbolization on thematic maps

Thematic mappers employ various types of symbols other than those listed above. Type styles and sizes used in the printing process are capable of conveying information to the map reader other than their strict word-meaning as, for example, the use of sloping letters in the naming of large bodies of water. Index numbers or lettering may be employed as well with reference to descriptive or explanatory text. Map legends often contain complex definitions. Graphs, such as those depicting rainfall in a particular place or region, may be entered directly on the map at the location of the station where the record of precipitation was obtained. Frequently thematic maps carry supplementary graphics such as bar graphs expressing data integral to the subject of the map but which appear either bordering it or included within the map outline. Information in tabular form is often handled in the same manner.

In Canada, federal government departments and universities are among the most active producers of thematic maps. Often such maps accompany the publication of scientific papers, particularly those relating to various aspects of the earth sciences. Important repositories of thematic maps in this country are national and provincial government atlases. Canada is second only to Finland in the issuing of an official national atlas. In 1899 Finland entered this field, to be followed by Canada in 1906 when the Atlas of Canada, prepared under the direction of Chief Geographer James White, was published by the Department of the Interior, Ottawa. This collection contained 40 sheets, consisting mainly of thematic maps dealing with geology, communications, precipitation, temperatures, census returns, drainage basins, and the plans of principal cities.

In 1915 a revised edition of the Atlas of Canada, prepared under the direction of Chief Geographer J. E. Chalifour, was published by the Department of the Interior. It contained 80 sheets consisting mainly of thematic maps dealing with the same topics portrayed in the 1906 atlas. Each of these atlases concluded with a series of diagram maps.

The Natural Resources Intelligence Service of that same federal department issued a publication in 1926 entitled *Canada as a National Property*. With the aid of a number of maps this work summarized natural and other resources of the nation and suggested how best these assets could be developed.

Another outstanding example of a federal government publication containing a number of thematic maps, *Canada's New Northwest*, was published by the North Pacific Planning Project in 1947. The maps portrayed the geology, agriculture, forests, water power, precipitation, trade volume and direction as well as the fishing and transportation industries of the region. These maps were compiled by the Drafting and Reproducing Division of the Bureau of Geology and Topography. The cartography was lithographed and printed by the Geographical Section, General Staff, Department of National Defence.

In the predominantly thematic and most recent Atlas of Canada, published in 1957, the foreword is especially illuminating.* Hon. Paul Comtois, then Minister of Mines and Technical Surveys, in an introductory message stated, in part, that "since the last Atlas of Canada appeared in 1915 the economy of Canada has expanded in all directions. The population of the country has doubled. Newfoundland has joined it as the tenth province, and scientific surveys have revealed to an ever-increasing extent the physical nature of its land and water resources. It is, therefore, the purpose of this edition of the Atlas to present, in maps, an outline of the physical background and the economic development of the nation at mid-century and to show how these factors are interwoven to produce the fabric of the life of our people . . ."

The aim of the 1957 Atlas, as described by Norman L. Nicholson, then Director of the Geographical Branch of the department, was to present "to the world at large a selection of authoritative maps of great accuracy . . . [to] indicate the growth of the economy and something of the extent of the social, cultural and other developments in the country." The Atlas of Canada story begins with descriptions of the exploration and early mapping of the northern half of North America. It continues with treatments of the basic aspects of physical environment, such as relief and climate. Then come maps of population origins and distribution. These sheets are followed, in turn, by those dealing with ways in which the natural resources of Canada are used and with transportation and communications networks that have developed as a consequence. A total of more than one hundred map plates was included in the volume, nearly all of which are thematic portrayals of important aspects of the country and its people. In the production of a national atlas, a project generally accomplished at a slow pace, a number of thematic maps are likely to be obviously out of date by the time of publication. This regrettable and, until now, characteristic defect can be remedied only by greatly expediting the processes of map compilation and printing.

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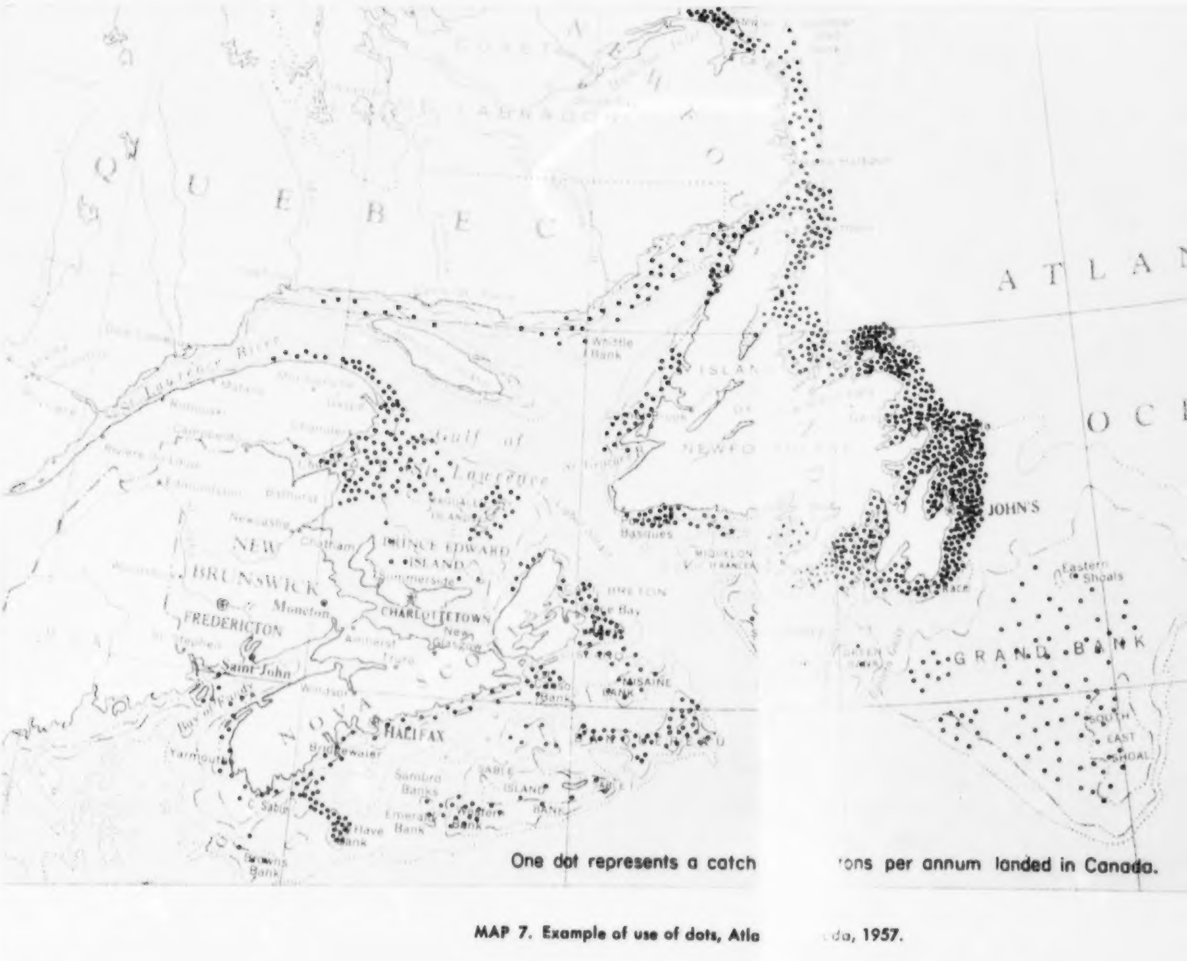
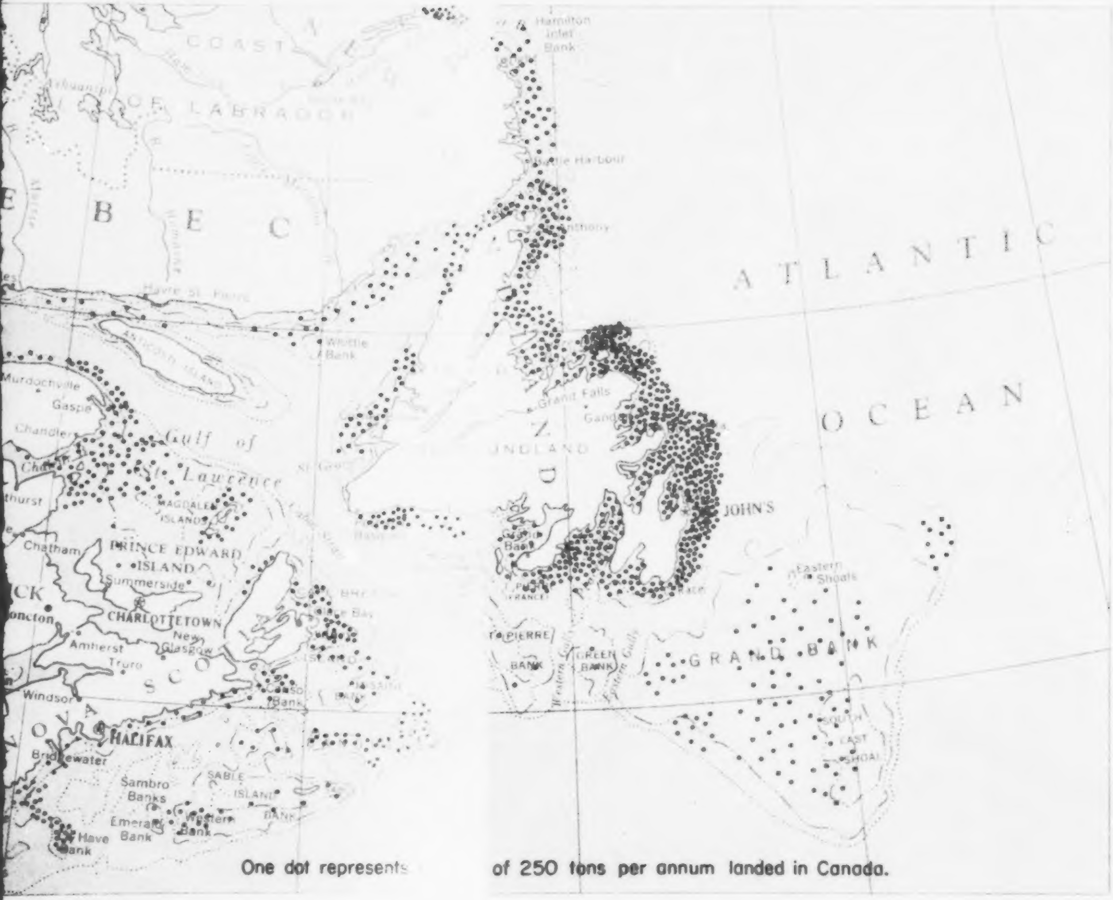
*Occasionally in this chapter atlases and maps therefrom, published after 1947, have been selected to illustrate future trends in Canadian cartography.


QUEBEC
LABRADOR
ATLAN
OC
St. Lawrence River
Gulf of St. Lawrence
Whittle Bank
NEWFO
NEW BRUNSWICK
FREDERICTON
Moncton
Saint John
Bay of Fundy
Chatham
Newcastle
Bathurst
PRINCE EDWARD ISLAND
Summerside
CHARLOTTETOWN
New Glasgow
Amherst
Truro
Windsor
HALIFAX
Yarmouth
C. Sable
Bridgewater
Sambro Banks
Emerald Bank
Western Bank
La Have Bank
Browns Bank
SABLE ISLAND BANK
MISAINE BANK
Basques
MIQUELON (FRANCE)
JOHN'S
Eastern Shoals
GRAND BANK
SOUTH EAST SHOAL

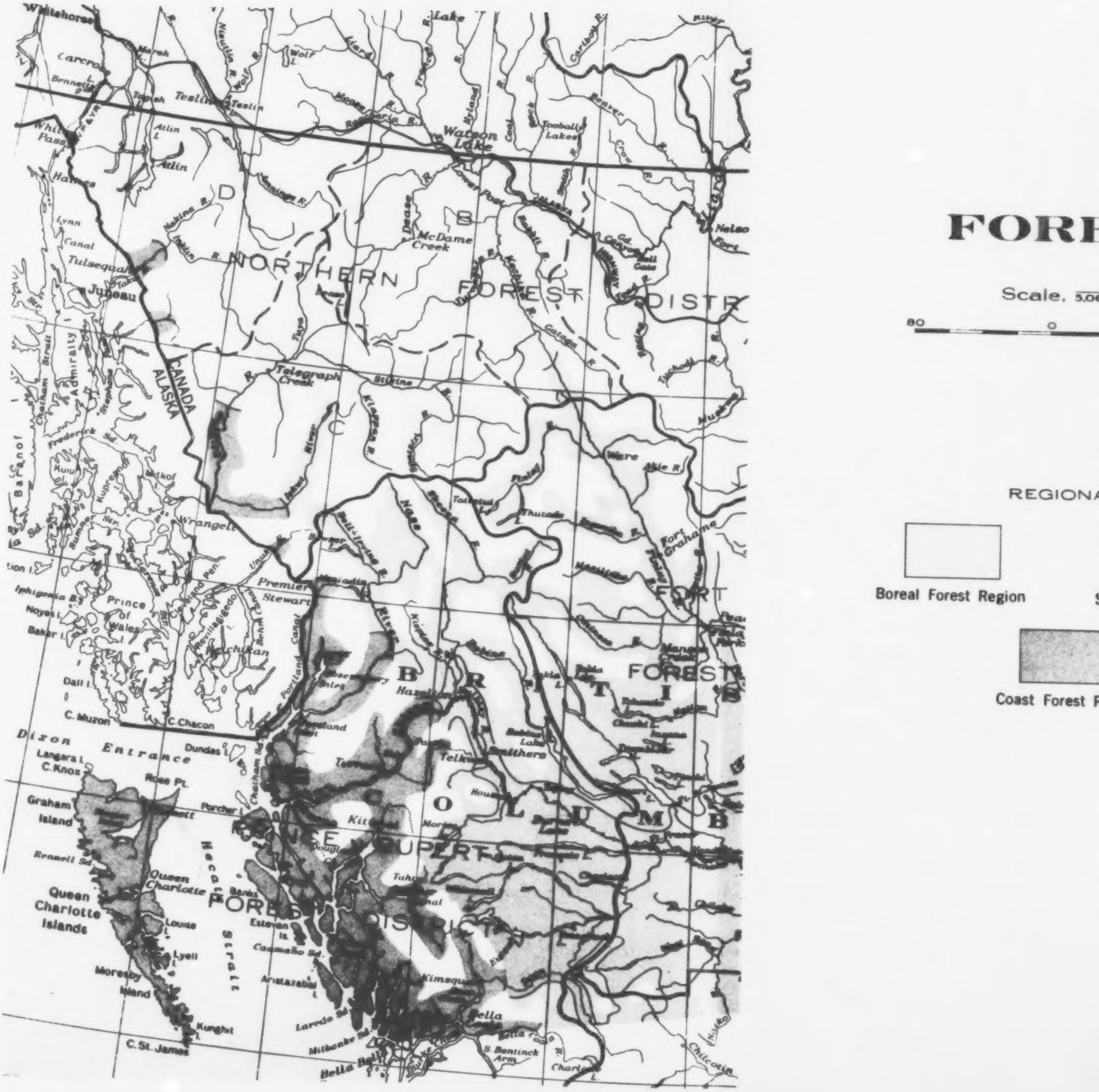
One dot represents a catch tons per annum landed in Canada.

MAP 7. Example of use of dots, Atla da, 1957.

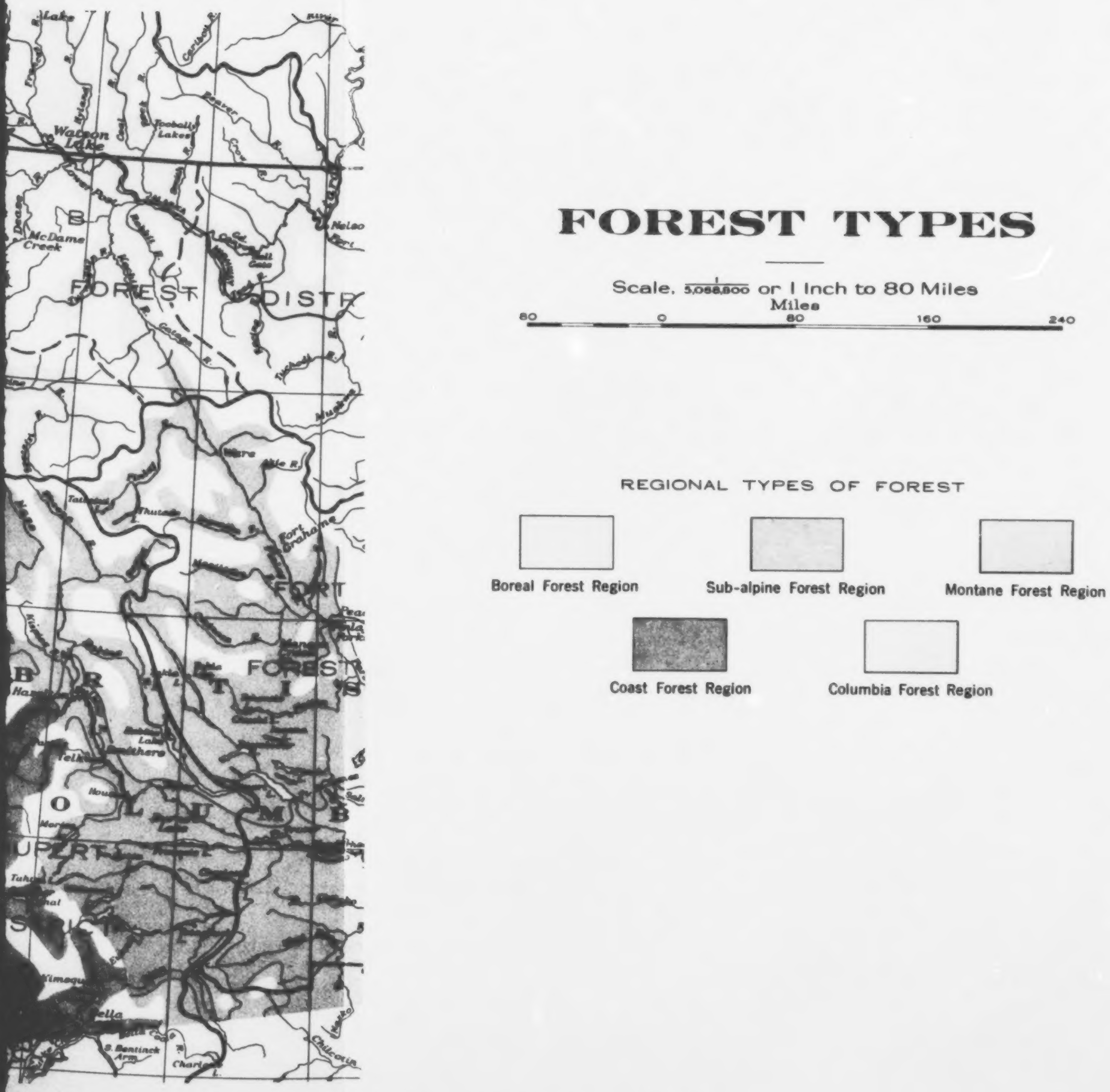

COAST OF LABRADOR
Hamilton Inlet Bank
Battle Harbour
St. Anthony
B E C
Havre St. Pierre
Whittle Bank
ATLANTIC
OCEAN
Murdochville
Gaspe
Chandler
Gulf of St. Lawrence
Bathurst
MAGDALEN ISLANDS
Chatham
PRINCE EDWARD ISLAND
Summerside
CHARLOTTETOWN
Moncton
Amherst
Truro
New Glasgow
Windsor
HALIFAX
Bridgewater
Sambro Banks
Emerald Bank
La Have Bank
Western Bank
SABLE ISLAND BANK
Grand Falls
Gander
NEWFOUNDLAND
ST. JOHN'S
St. George
ST. PIERRE BANK
GREEN BANK
Eastern Shoals
GRAND BANK
SOUTH EAST SHOAL

One dot represents of 250 tons per annum landed in Canada.

MAP 7. Example of e c s of Canada, 1957.


FORE
Scale
80
0
REGIONA
Boreal Forest Region
Coast Forest R
Whitehorse
Carcross
Teslin
Atlin
Watson Lake
Juneau
Haines
Telegraph Creek
Wrangell
Stewart
Ketchikan
Prince of Wales
Hazelton
Smithers
Kitimat
Bella Coola
Bella Bella
Fort Grahame
McDame Creek
CANADA
ALASKA
NORTHERN FOREST DISTRICT
PRINCE RUPERT FOREST DISTRICT
BRITISH COLUMBIA
FORT
FOREST
Dixon Entrance
Hecate Strait
Graham Island
Queen Charlotte Islands
Moresby Island
C. St. James
C. Muzon
C. Chacon
Baranof
Chatham Strait
Admiralty
Lynn Canal
Stikine R.
Nass
Skeena

MAP 8. Part of thematic map produced by North Pacific Planning Project, 1947, showing forest types.


FOREST TYPES
Scale, 1/5,068,800 or 1 Inch to 80 Miles
Miles
80
0
80
160
240
REGIONAL TYPES OF FOREST
Boreal Forest Region
Sub-alpine Forest Region
Montane Forest Region
Coast Forest Region
Columbia Forest Region
Watson Lake
McDame Creek
FOREST DISTR
Fort Grahame
FORT
FOREST
B R I T I S
O L U M B
Babine Lake
Smithers
Telkwa
Bella Coola
S. Bentinck Arm
Chilcotin

MAP 8. Part of thematic map produced by North Pacific Planning Project, 1947, showing forest types.

Quebec

The Bureau of Surveys and the Bureau of the Cadaster in the provincial government service of Quebec sponsor the preparation and publication of series of maps. In the case of the former agency, map sheets have been issued covering judicial districts of the province and of Laurentides National Park as well as of seigniory and township lines, without relief, but showing railway lines, and roads. The Cadastral Bureau issues county maps designed to depict municipal boundaries, ranges, and numbered lots of seigniories and townships. Most of these were reprinted from 1935 to 1940. From 1912 on, the Quebec Streams Commission has illustrated its annual reports with river profiles and depths of lakes. The Forestry Service of the province also publishes maps on forest inventories and forest classifications. The Quebec Meteorological Bureau plots data on maps but has not issued sheets except on special request. The Department of Mines of the province, from 1898 on, has issued hundreds of separate geological maps. The Department of Municipal Affairs, Industry and Commerce established an Economic Map Service in 1942, mainly to compile and publish maps designed to accompany soil survey reports, forest inventories, and the Inventory of Natural Resources.[5]

Ontario

In the period under review in this chapter four departments of the government of Ontario carried on mapping and map-making activities. These were Lands and Forests, Mines, Agriculture, and Highways. In the Department of Lands and Forests two branches, Surveys and Forestry, were actively and continuously engaged in collecting data and in making maps. The Department of Mines of the province began to issue maps in 1891. The Department of Highways produced provincial road maps, revised annually. The Department of Agriculture publishes soil maps, patterned after those of the United States Soil Survey. In 1943 a soil erosion and land-use survey report on Durham County was accompanied by a map covering an area of about 22,000 acres in central Ontario. The Ontario Research Foundation, Toronto, is not a department of the provincial government but an endowed body reporting directly to the premier of Ontario. Climatic statistics have been utilized as material for a series of isopleth maps published by the Foundation. Certain soil survey maps of Ontario, on a county basis, are produced by the Department of Chemistry in what is now the University of Guelph in cooperation with the Experimental Farm Service, Ottawa. In 1941 the Forestry Branch produced the Ontario Forest Atlas for use in the schools of the province. This publication contains 14 maps, mostly thematic, concerning forests, forest protection, pulpwood concessions, pulp and paper mills, hydro-electric and mining projects, road and rail transportation in northern Ontario as well as in Crown game preserves.

British Columbia

The British Columbia Atlas of Resources was published in 1956 by the provincial government-supported British Columbia Natural Resources Conference. The provincial Surveyor General and Director of Surveys G. S. Andrews gave assistance in the form of expert advice on the suitability of base maps for this publication and also extended to the project the services of many of his staff. Premier W. A. C. Bennett, in a prefatory statement in the volume, drew attention to the fact that the appearance of the Atlas coincided closely with British Columbia's centennial year. "I wish to congratulate the more than 100 members and associates of the Conference", the premier wrote, "who, over a period of more than two years, turned a magnificent concept into this atlas achievement. The book represents a community of effort in the best Canadian tradition, an original and major accomplishment of a volunteer group whose devotion to the harmonious and integrated development of all our national resources, of men with the land, is well known . . . The fact is recorded here that this atlas is unique in North America, presenting for the first time for any province or state, in colour map form and in associated text and photographs, the story of the people and their resources."

The cartographic editors of this project, in which the University of British Columbia was also actively involved, were A. L. Farley and R. I. Ruggles. Each of the 48 map sheets was prepared specifically for this volume. Thematic maps predominated in this collection and dealt with such topics as meteorology, precipitation, mean daily temperatures, agriculture, fisheries, mining, energy production, recreation, water, distribution of population based on the 1951 federal census returns, explorations and surveys, wildlife, transportation, and manufacturing.

Manitoba

Work proceeded for a number of years on an Economic Atlas of Manitoba under the direction of Professor T. R. Weir of the provincial university. This collection of maps, nearly all thematic, was published by the Manitoba Department of Industry and Commerce. It is composed of 37 map sheets, divided into three categories: Resource Base; Population and Settlement; and Resources Use. The first part or category consisted of maps depicting drainage, geology, glaciation, soil types, temperatures, and precipitation. The second part included maps on rural and urban population, population density, native peoples, and ethnic groups. The third depicted types of farming, crops, and wildlife; also water resources, electric power production, mines and minerals, fishing recreation, transport, and manufacturing.

New Brunswick

Apart from atlas projects some Canadian provinces and some private firms produce, from time to time, separate thematic map sheets. In New Brunswick in the 1940s maps were being made conveying information gathered during forest surveys. In these maps topography was subordinated to types of timber. A map of the province portraying motor roads, railways, and recreational resources was published in 1938 by the New Brunswick Department of Lands and Mines.

Alberta

In Alberta, soil maps were issued by the provincial Department of Agriculture in this period in cooperation with the University of Alberta. In addition, in 1941, Alberta Publicity Director Campbell issued a map showing railways, highways, airports, trails, irrigation canals as well as cities and towns. Information on provincial flora and natural resources was superimposed on a topographic base.

Saskatchewan

In Saskatchewan maps issued by the provincial Department of Agriculture depicted the incidence of hail and grasshopper infestation. The department also issued blueprint dot maps showing distribution in the province of cattle, sheep, horses and hogs, based on 1936 census data. Soil maps were published also. The provincial Department of Natural Resources published maps of Saskatchewan's forests and provincial parks as well as fire-protection maps.

Prince Edward Island

The island province claims the distinction of publishing in 1925 the first of the official provincial atlases to appear in Canada, namely, the Atlas of Province of Prince Edward Island and the World. This publication resembles a county atlas of the type produced in central Canada in fair numbers during the last half of the 19th century and the early years of the 20th century. The cadastral map of each lot of real property in the several counties of the province was reproduced in this collection, showing the owner's name in each case. These sheets also served as population maps.

Northwest Territories

Under the direction of W. O. Kupsch an atlas of the region was prepared as a working paper for the Advisory Commission on the Development of Government in the Northwest Territories. The results were published in 1966. All maps contained in this collection were draughted by W. Loates and Associates, Ottawa, and included portrayals of mineral resources, Royal Canadian Mounted Police detachment posts, transportation services, forest resources, tundra areas, ice cover, snow cover, temperatures, geology, and wildlife resources.

Thematic maps and thematic map conventions are being used increasingly by many sciences, particularly earth sciences, to communicate information on two- or three-dimensional distributions. In the realm of cartography thematic mapping offers a challenge to all who are interested in the development of more effective methods of communication by graphic media.

When mapping by means of computers becomes common procedure, a development that now appears to be inevitable, there is every prospect that information for all types of thematic maps will be stored in data banks for retrieval and use when required. This process of digitizing cartographic information for the "storing" of maps is certain to lead to the production of a greater number and variety of up-to-date thematic maps.

GLOSSARY

Conventionalized Landscape: The depiction of an area as it is experienced but conventionalized to the degree of including only a standard set of items.

Flow map: One depicting measurement, by the use of lines and bands, of moving phenomena in terms of volume, direction, intensity, etc.

Isogram: An over-all term denoting a large family of cartographic expressions using the prefixes "iso" or "isa" to describe lines involving the factor of equal values.

Isarithm: (isometric line): A line that represents constant value obtained from measurement at a series of points (see Map 6).

Isopleth: A type of isogram, being a line connecting points *assumed* to have equal values.

Qualitative Mapping: Expresses the nature, quality, or type, in a descriptive sense, of the matter being mapped (see Map 8).

Quantitative Mapping: Mapping based on values measured in terms of numerical expressions (see Map 5).

15

THE GEOLOGICAL SURVEY OF CANADA: THIRTY YEARS OF MAPPING, 1917-1947

"Give me the map there."
—*King Lear*, Act 1, Sc. 1.

Three years after the Geological Survey of Canada came into being under Logan the Parliament of the Province of Canada confirmed, in statutory form, that the Survey had been organized "to make an accurate and complete Geological Survey of this Province, and to furnish a full and scientific description of its Rocks, Soils and Minerals which shall be accompanied with proper Maps, Diagrams and Drawings . . ."[1] That was in 1845.

Cartographic functions of the organization were re-emphasized in sections 5 and 8 of the act establishing the Geological Survey *Department* in 1890. In 1907 in the Geology and Mines Act (ch. 29, 6-7 Ed. VII), under which the Department of Mines of Canada was created, these particular duties of the Survey were repeated in section 21, with the italicized words added:

"The Minister may, for the purpose of obtaining a basis for the representation *of the mineral, mining and forestry resources and* of the geological features of any part of Canada, cause such measurements, observations, investigations and physiographic, exploratory, and reconnaissance surveys to be made as are necessary for or in connection with the preparation of *mining,* geological *and forestry* maps, sketches, plans, sections or diagrams." This legal arrangement of words might appear, in the eyes of geologists, to place the cart before the proverbial horse. Such scientists would be more inclined to the view that the functions of cartographic portrayal are subservient to knowledge gained in the field and that mapping is but the means to an end.

A good geological map is much more than an objective depiction of facts. It is, as well, a subjective presentation of interpretations based upon numerous observations as well as on theories regarded as valid at the time the map was made. Although at first glance geological maps appear to be static and timeless, such is not the case. As geological science evolves, so also will geological maps continue to depict developing concepts.[2]

In the preparation of such maps the Canadian geologist, during at least part of the time span under review in this chapter, commenced his task equipped with an accurate topographic map or maps and with air photographs of the area under his investigation. Prior to 1908 the geologist in this country had no alternative but to draw his own topographic base maps. But since that year topographers, organized in a division within the Geological Survey, provided him with this type of cartography. Thus equipped, and before he attempted to convey any geological information on a map, he decided upon the classification by origins of the various rocks coming under his examination. He would make a statistical analysis of hundreds of field observations in order to determine the shape of folds, the positions of faults, or the significance of fossil clusters. Included in his map would be interpretations of geochemical analyses and geophysical measurements. The geologist also selected map symbols along with a general scheme of presentation to enable the map user to peer deeply into the mapped structure and to visualize the distribution and relationship of rocks beneath the surface of the earth. All these tasks were accomplished within the statutory reference provided for the guidance of the embryo organization.

By the time of the First World War, seventy years after the Geological Survey's original guidelines had been given legislative expression, its mapping and related functions had resulted in the establishment of several new divisions within the organization. In addition to the Topographical Division in charge of W. H. Boyd, a Geographical and Draughting Division and a Photographic Division were in operation. In order to reduce possibilities of confusion in the minds of readers, the topographical survey work of the Geological Survey will be identified in this chapter as T.S.G.S. in order to help distinguish this organization from other federal topographic mapping agencies, such as those of the departments of the Interior (under the Surveyor General) and of National Defence. But it should be kept constantly in mind that three distinct stages of cartography are involved in geological field work and its aftermath, namely, the provision of base maps by the T.S.G.S., geological mapping by the geologist himself, and, thirdly, map draughting and reproduction by or through the division of that name functioning within the Geological Survey.

On occasion mapping in the field was adventuresome to the point of extreme danger. K. G. Chipman, for instance, was fortunate to survive an encounter with a grizzly bear in British Columbia. Chipman was chief at the time of a T.S.G.S. party that had camped one evening on the bank of Mineral Creek. He had started out to examine the mountainside at the rear of the tents in order to discover the most feasible way to scale the steep slope on the following day. After a while the topographer sat on a log to rest himself when, without warning, a bear charged savagely toward him out of some nearby bushes.

As Chipman rose to his feet he caught sight of a pair of bear cubs to one side and behind him. Unwittingly he had placed himself between a female grizzly and her young. Firing one shot from his rifle at the onrushing animal the mapper turned and raced down the steep mountainside. The bear followed at such speed that she rushed past him before she could check herself. Instantly Chipman turned and ran back up the hill. Because a bear can climb a steep slope with relative ease the grizzly soon caught Chipman and began to shake him as a terrier would a rodent. Luckily the fierce shaking motion caused the enraged animal to lose its footing and both bear and man rolled together some distance downhill before coming to rest.

At this point Chipman displayed commendable presence of mind. On being stopped by a bush he lay perfectly still, feigning death. The grizzly sniffed him thoroughly and then, apparently satisfied that he was dead, ambled off to join her cubs. Members of the party carried their injured chief to camp and made him as comfortable as possible. A doctor was brought to the campsite after some difficulty and delay. He found that the leather leggings worn by Chipman had saved from serious injury his right leg below the knee. The knee of the left leg, however, and the part above the knee was painfully ripped and inflamed. Otherwise, except for minor scratches and torn clothing, Chipman remained in one piece. Several of his party worked hard to cut a trail through timber in order that the injured man could be carried to a hospital. There Chipman recovered fully from the effects of the vicious mauling he had received.[3]

In 1916, in order to make possible closer supervision of geological parties in the field, Canada was divided from coast to coast into seven administrative districts. Each of these districts, for purposes of geological investigation, was placed under a member of the Geological Survey staff in the following arrangement: Nova Scotia (E. R. Faribault); Eastern Quebec and New Brunswick (G. A. Young); Precambrian Ontario and Quebec (W. H. Collins); Great Plains (D. B. Dowling); Northern Exploration (C. Camsell); British Columbia (O. E. LeRoy); and Northern British Columbia and the Yukon (D. D. Cairnes).

FIGURE 128. D. B. Dowling.

This was a wise, constructive and forward-looking step but, in general, the regime of William McInnes (1858-1925), who had succeeded Reginald Walter Brock in 1914 as Director of the Geological Survey, was marked by disruptions which he could not avoid but which he did his best to mitigate. His special abilities as a leader were brought into full play as he began his six-year term as director in the early days of the First World War. The staff of the Survey was depleted in two ways at this stage of its history.

Not only did the Survey lose a number of experienced members by enlistment in the armed services, many university graduates in geology also enlisted instead of commencing their careers as members of summer field survey parties. When the war ended most of the former staffers returned to the Survey. But the losses were profoundly felt. Major W. E. Lawson, a senior topographer, had been killed in France. Capt. O. E. LeRoy, who had been in charge of field work under Brock, was lost at Passchendaele. J. D. MacKenzie worked for a few seasons in the field following active service overseas but died in 1922 as a result of war wounds; he had just completed detailed geological mapping and study of structures in the northern part of the coal basin in the vicinity of Nanaimo on Vancouver Island.

A wartime catastrophe within Canada also hampered, for a time, the work of the Survey. After the destruction by fire of the Parliament Buildings in Ottawa on the night of February 3-4, 1916, it became necessary to provide, without delay, suitable accommodation for both houses of Parliament then in session. The Victoria Memorial Museum was considered to be the best available building in the capital for that purpose. But as the structure was fully occupied by administrative offices of the Department of Mines as well as by the offices and museum of the Geological Survey, a rapid, large-scale transfer operation became imperative. On the morning of February 4 the moving of staff and equipment began. The House of Commons met in the auditorium of the Museum building in the afternoon of that day. The swiftness of the transformation was made possible by the willing cooperation of all on the Geological Survey staff and of Mines Department officials. With only a few exceptions the Survey organization made its new home in government-owned premises on the north side of Wellington Street, west of Bank Street.[4]

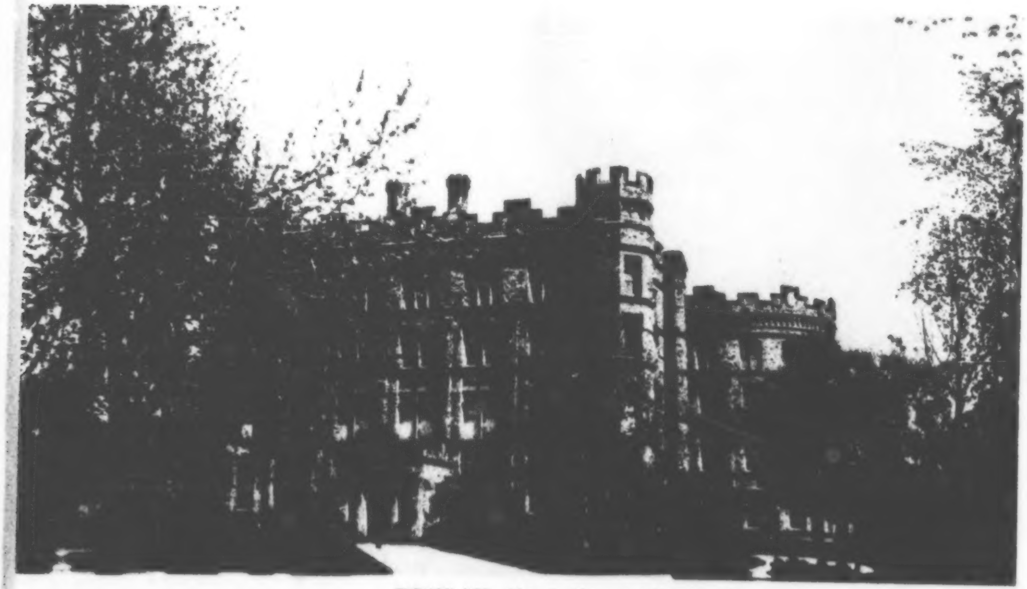


FIGURE 129. Victoria Memorial Museum, Ottawa.

FIGURE 130. William McInnes.

In the immediate post-war years McInnes faced formidable personnel problems. Salary increases came but slowly in the civil service in those days. At the same time offers of more lucrative rewards were being made to federal geologists by universities and mining companies. In a number of cases these attractive opportunities were accepted. Despite such set-backs the Geological Survey program for the summer season of 1919 covered a wide range of investigations. For example, E. M. Kindle continued field work in the Mackenzie River basin, giving particular attention to the stratigraphy of the area in which indications of petroleum had just been discovered by the Imperial Oil Company. F. J. Alcock spent the season collecting data essential to the geological mapping of a part of northern Manitoba. W. H. Collins continued his study of iron formations in the Michipicotin district of Ontario. He gathered sufficient geological and geographical information, including a survey of canoe routes in the area, to construct a map covering 500 square miles on a scale of one mile to the inch. This cartography proved to be quite suitable for prospecting and other exploratory needs.[5]

Clovis-Omer Senécal, Chief Draughtsman of the Geological Survey, reported that 41 new geological maps had been published during 1919 and that 19 other maps were in the hands of the King's Printer for engraving, lithographing and printing.* In addition, 35 other maps were in various stages of progress. A large number of sketches, diagrams and figures for illustrating various publications of the Survey had been prepared as well.

Early in 1920 parliamentarians returned to the Hill where a magnificent new edifice had been constructed. The staff of the Geological Survey then moved back to quarters in the Victoria Memorial Museum. In May of that year a young Manitoban and former pilot in the Royal Air Force, who had served as a student assistant on Geological Survey field parties from 1913 to 1917, joined the permanent staff as assistant geologist. He was Dr. George Hanson (1891-1967), destined to become head of the organization in 1943.

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*The King's Printer did not print maps on his Ottawa premises but distributed such work, under contract, to commercial firms in Canada.

The year 1920 also marked the addition of Dr. George Sherwood Hume (1893-1965) to the Survey staff. Dr. Hume also developed into a leader in this field. In June, 1920, Charles Camsell was promoted from the staff of the Geological Survey to the position of Deputy Minister of Mines. In November of that year William Henry Collins (1878-1937) became Director of the Geological Survey. McInnes was placed in charge of the organization's new museum and also functioned as chief editor, Department of Mines, occupying this dual role until his death on March 10, 1925. During nearly 45 years of service to Canada McInnes had seen the Geological Survey's displays and collections, which formed the core and basis of the Victoria Memorial Museum in Ottawa, grow from very small proportions into an agency of special importance in the educational and scientific circles of this country.

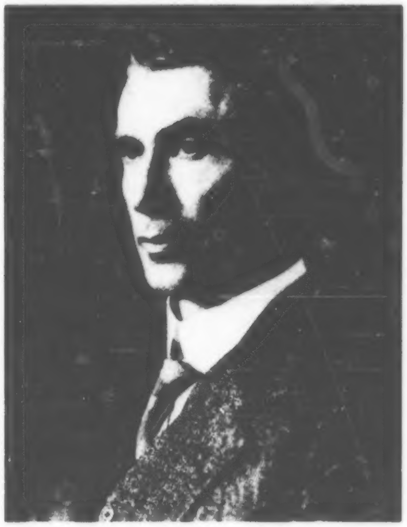
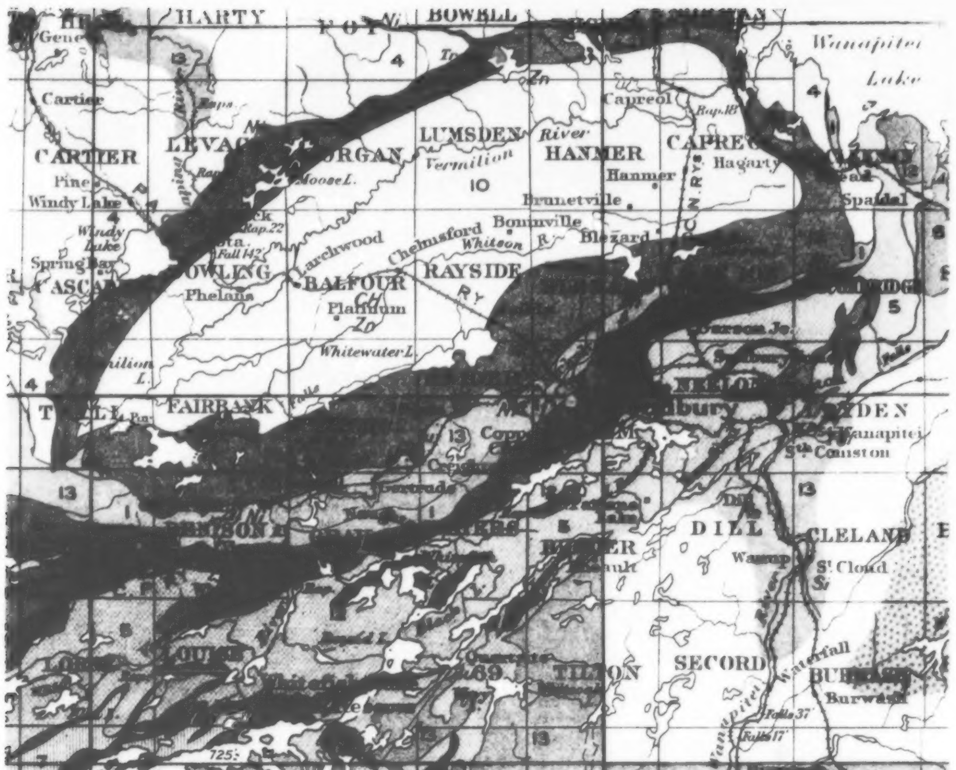


FIGURE 131. W. H. Collins.

Between 1915 and 1920, when the energies of so many Canadians on the home front were concentrated more upon production from known resources than upon the discovery and development of new sources, operations of the Geological Survey became restricted largely to problems of mineral output in districts within easy reach of transportation facilities. Exploratory work was almost completely suspended. With the return of more normal economic conditions in the early 1920s public attention was directed once again to the search for mineral deposits. In keeping with this change in emphasis the Geological Survey resumed its exploratory operations and related mapping activities.[6]

For some years the Geological Survey had been handicapped by a lack of accurate, large-scale topographic maps, a type of aid indispensable to effective geological field work. Gradually, however, the T.S.G.S. recovered its pre-war strength of personnel and vitality. This resurgence brought about a marked increase in work output along with renewed hopes for continuing expansion. In the Survey's annual report for the 1922 field season the comment was made that "the topographical parties, while engaged in preparing base maps for geological use, mainly in areas containing mineral deposits, are producing


HARTY
BOWELL
Wanapitei Lake
Cartier
Capreol
CARTIER
LEVACK
MORGAN
LUMSDEN
River
HANMER
CAPREOL
Vermilion
Hanmer
Hagarty
Pine
Windy Lake
Moose L.
10
Brunetville
Spaidal
Windy Lake
Rap. 22
Larchwood
Chelmsford
Bonnville
Whitson R.
Blezard
Spring Bay
DOWLING
BALFOUR
RAYSIDE
Phelans
Cu
Planium
Zn
Ry
Whitewater L.
Vermilion L.
Garson Jc.
FAIRBANK
Sudbury
NEELON
DRYDEN
Wanapitei
Coniston
Copper Cliff
13
DILL
CLELAND
Wanup
St. Cloud
SECORD
TILTON
Waterfall
BURWASH
Burwash
Wanapitei
Falls 37
Falls 17
725
Lake
LAURA
SERVOS
60
67
WALDIE
COX
CARLYLE
HUMBOLDT
KILPATRICK
ALLEN
TRAVERS
Killarney
George I.
Killarney
Green I.
Grondine Pt.
Key Harbour
Scale, $\frac{1}{506,880}$ or 1 Inch to 8 Miles
GEORGIAN BAY

MAP 9. Part of Lake Huron sheet, Map 155A,

KILLARNEAN BATHOLITHIC INTRUSIVES

13 — *Granite, gneiss and pegmatite rich in potash. Recrystallized sedimentary inclusions usually abundant.*

KEWEENAWAN (?)

Mostly sills and dykes of quartz diabase and quartz norite. Included with these are various other intrusive types and some basic lava flows of uncertain Huronian ages.

HURONIAN

WHITEWATER

10 — **CHELMSFORD**, *gray feldspathic quartzite.* **ONWATIN**, *dark gray to black carbonaceous slate.* **ONAPING**, *agglomerate and coarse to fine tuffs, in ascending order.*

COBALT

9 — **UPPER WHITE QUARTZITE**
BANDED CHERTY QUARTZITE, *varicoloured thin-bedded silty and calcareous quartzite.*
LORRAIN, *impure to pure white quartzite; quartz and red jasper conglomerate.*

GOWGANDA, *a variable assemblage of boulder conglomerate, greywacke and impure quartzite of glacial or frigid-climate origin.*

BRUCE

7 — **SERPENT**, *white feldspathic quartzite.*

ESPANOLA, *recrystallized calcareous silt and magnesian limestone thinly interbedded in varying proportions.*
BRUCE CONGLOMERATE, *boulder conglomerate and some greywacke.*

5 — **MISSISSAGI**, *mostly feldspathic white quartzite with rare lenses of quartz conglomerate; some argillite members.*
RAMSAY LAKE, *boulder conglomerate and arkose.*

PRE-HURONIAN

BATHOLITHIC INTRUSIVES

4 — *Granite, gneiss and pegmatite poor in potash. Evidently includes a group* (**ALGOMAN**) *younger than* (**2**), *and another* (**LAURENTIAN**) *group older than* (**2**), *but not separable.*

3 — *A complex of igneous granite and gneiss and recrystallized sediments (quartzite, paragneisses and crystalline limestone) of Grenville-like appearance. Hitherto believed contemporaneous with* (**4**), *but probably the igneous portion is partly or altogether equivalent to* (**13**).

SEDIMENTS

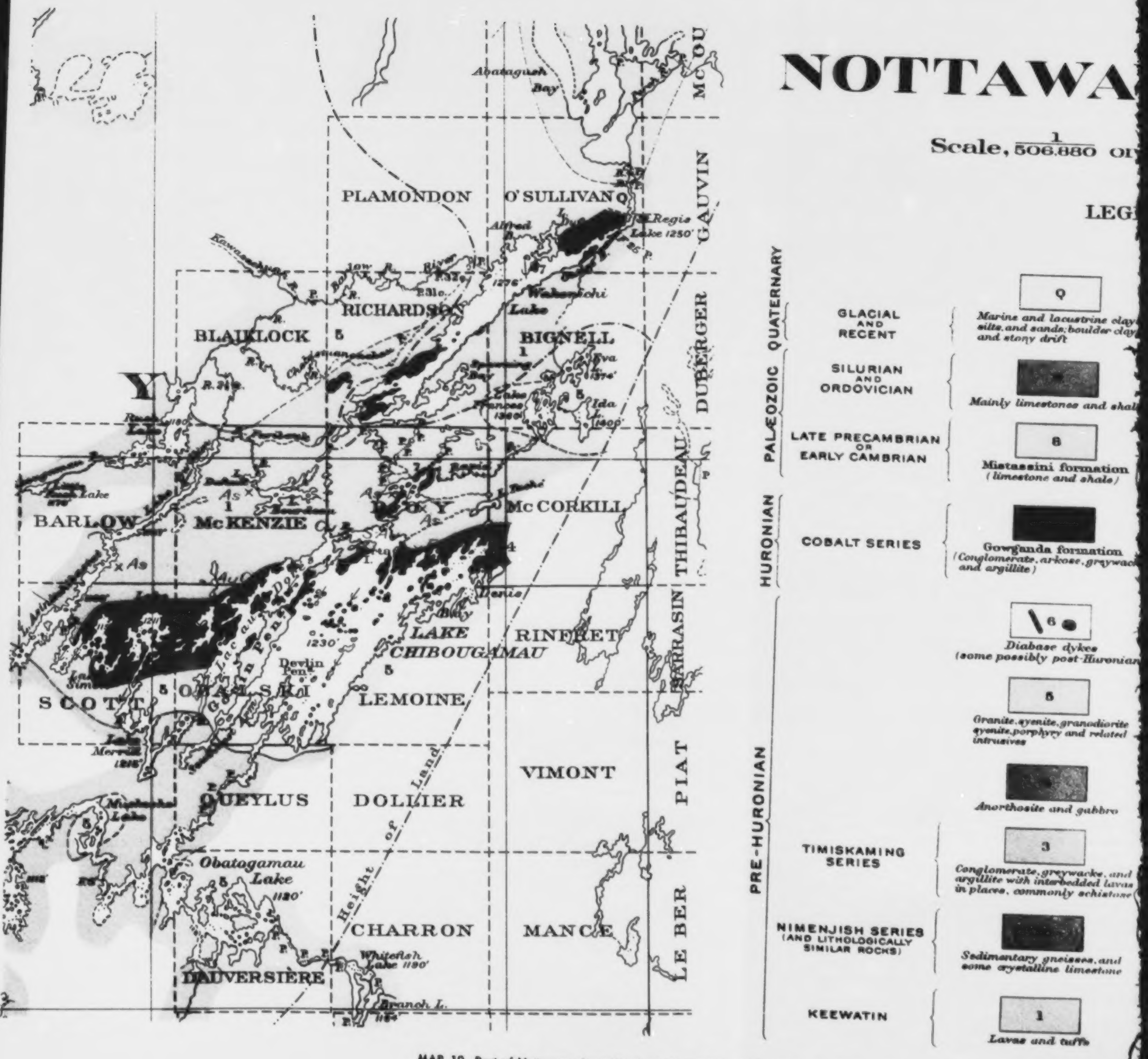
DORÉ SERIES (2a), SUDBURY SERIES (2b), TIMISKAMING SERIES (2c), BATCHAWANA, RIDOUT, KIASK, *and other series* (**2**).
Clastic assemblages consisting of (some or all) boulder conglomerate greywacke, impure quartzite and volcanics. These series occur at different horizons in (**1**), *and are evidently not of the same age.*

VOLCANIC COMPLEX (KEEWATIN)

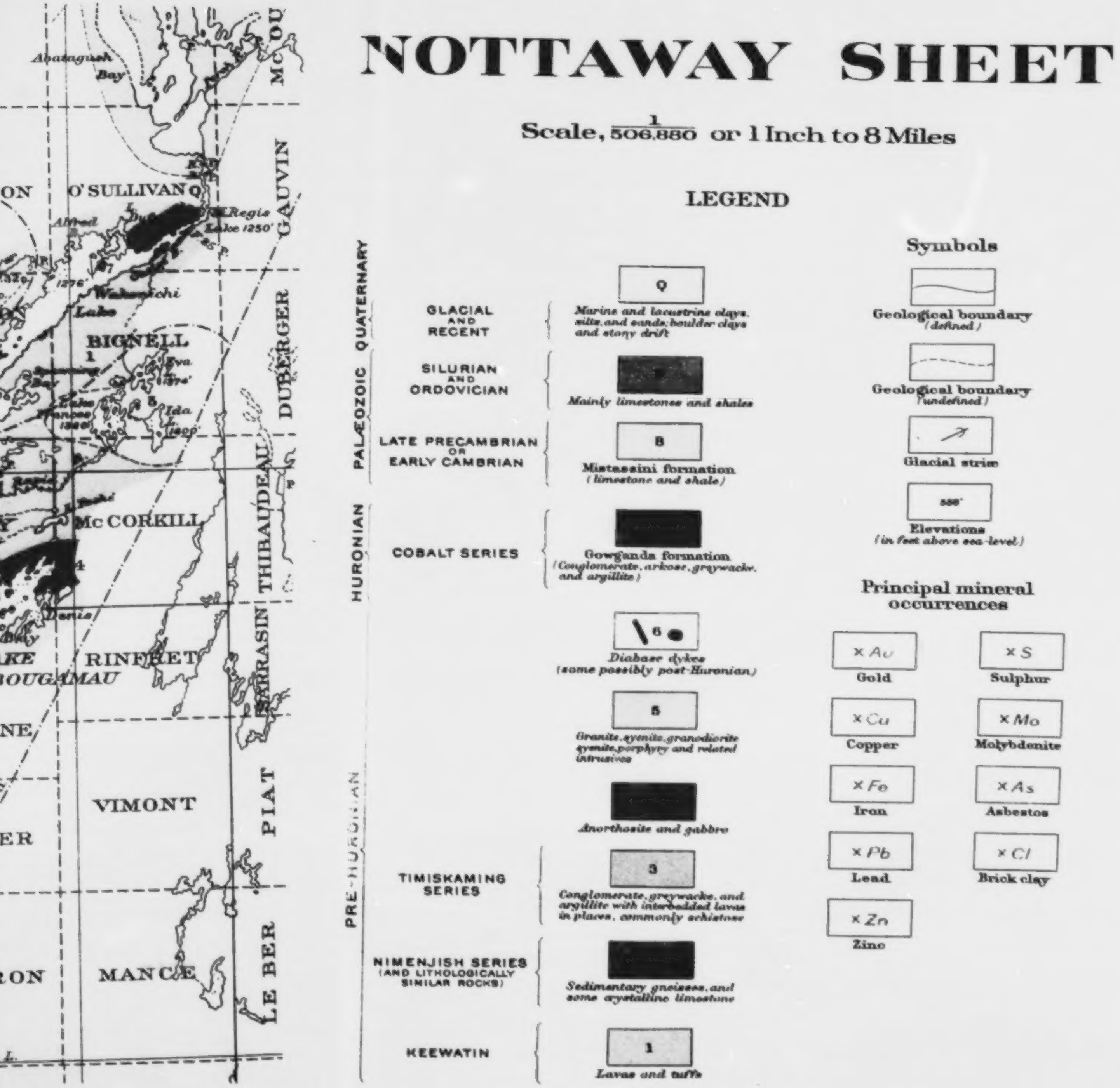
— — *Iron formations, or local deposits of banded silica, carbonate and sulphides that occur throughout* (**1**).

1 — *A schisted complex, mainly of lavas but including local sedimentary deposits.*

ublished by the Geological Survey of Canada, 1933.


NOTTAWA
Scale, 1/506,880
LEG
PLAMONDON
O'SULLIVAN
BLAIKLOCK
RICHARDSON
BIGNELL
BARLOW
McKENZIE
ROY
McCORKILL
SCOTT
OBALSKI
LEMOINE
RINFRET
QUEYLUS
DOLLIER
VIMONT
CHARRON
MANCE
DAUVERSIÈRE
GAUVIN
DUBERGER
THIBAUDEAU
BARRASIN
PIAT
LE BER
LAKE CHIBOUGAMAU
Waconichi Lake
Regis Lake 1250'
Abatagush Bay
Obatogamau Lake 1120'
Whitefish Lake 1190'
Branch L.
Height of Land
Devlin Pen.
Lake Merrill 1215'
Fva
Ida
Lake Frances
PALÆOZOIC
QUATERNARY
HURONIAN
PRE-HURONIAN
GLACIAL AND RECENT
Q
Marine and lacustrine clays, silts, and sands; boulder clay and stony drift
SILURIAN AND ORDOVICIAN
Mainly limestones and shale
LATE PRECAMBRIAN OR EARLY CAMBRIAN
6
Mistassini formation (limestone and shale)
COBALT SERIES
Gowganda formation (Conglomerate, arkose, graywacke and argillite)
6
Diabase dykes (some possibly post-Huronian)
5
Granite, syenite, granodiorite syenite, porphyry and related intrusives
Anorthosite and gabbro
TIMISKAMING SERIES
3
Conglomerate, greywacke, and argillite with interbedded lavas in places, commonly schistose
NIMENJISH SERIES (AND LITHOLOGICALLY SIMILAR ROCKS)
Sedimentary gneisses, and some crystalline limestone
KEEWATIN
1
Lavas and tuffs

MAP 10. Part of Nottaway sheet (Quebec), Map 109A, published by the Geological Survey of Canada, 1927.



NOTTAWAY SHEET
Scale, 1/506,880 or 1 Inch to 8 Miles
LEGEND
QUATERNARY
GLACIAL AND RECENT
Q
Marine and lacustrine clays, silts and sands; boulder clays and stony drift
PALÆOZOIC
SILURIAN AND ORDOVICIAN
Mainly limestones and shales
LATE PRECAMBRIAN OR EARLY CAMBRIAN
B
Mistassini formation (limestone and shale)
HURONIAN
COBALT SERIES
Gowganda formation (Conglomerate, arkose, greywacke, and argillite)
6
Diabase dykes (some possibly post-Huronian)
5
Granite, syenite, granodiorite syenite porphyry and related intrusives
Anorthosite and gabbro
PRE-HURONIAN
TIMISKAMING SERIES
3
Conglomerate, greywacke, and argillite with interbedded lavas in places, commonly schistose
NIMENJISH SERIES (AND LITHOLOGICALLY SIMILAR ROCKS)
Sedimentary gneisses, and some crystalline limestone
KEEWATIN
1
Lavas and tuffs
Symbols
Geological boundary (defined)
Geological boundary (undefined)
Glacial striæ
550'
Elevations (in feet above sea-level)
Principal mineral occurrences
× Au
Gold
× S
Sulphur
× Cu
Copper
× Mo
Molybdenite
× Fe
Iron
× As
Asbestos
× Pb
Lead
× Cl
Brick clay
× Zn
Zinc
Abatagush Bay
McOU
ON
O'SULLIVAN
Alfred
Regis Lake 1250'
1276'
Wakonichi Lake
BIGNELL
1
Eva
Frances Lake
Ida
GAUVIN
DUBERGER
THIBAUDEAU
McCORKILL
4
RINFRET
AKE
BOUGAMAU
SARRASIN
NE
VIMONT
ER
PIAT
RON
MANCE
LE BER

AP 10. Part of Nottaway sheet (Quebec), Map 109A, published by the Geological Survey of Canada, 1927.

these maps on scales and according to standards which make them contributory to the systematic primary mapping of the country."

In 1921 the Survey staff was augmented, in its map reproduction work, by a unit of four copperplate map engravers transferred from the Printing Bureau. This action had been taken following a government decision to distribute its copperplate engravers among the principal map-making departments in Ottawa. Although continuing as nominal employees of the Department of Public Printing and Stationery, Robert Veitch, J. W. Tuttle, A. Stewart and W. W. Arnold were placed with the Geological Survey and exercised their special craft as part of its staff. By early 1922 this unit, with Veitch in charge, had completed the engraving of a series of postal maps for the Post Office Department as well as a chart for the Hydrographic Survey of Canada. About this time the Geological Survey was divided, in its map-making functions, into a Geographical and Draughting Division with Omer Senécal as chief, and a Map Engraving Division under Veitch.

Over a number of years a gradual change had taken place in the nature of the principal activities of the Geological Survey. For a prolonged period following its formation the Survey, although essentially geological in character, was the only government or other organization in Canada engaged in the task of assembling reliable information on the natural resources of this country. Later on, various federal and provincial government agencies began to function in resource fields. Accordingly the Geological Survey of Canada turned from its initial concern with the broader picture to a steadily growing preoccupation with the needs of a prosperous, vigorous and rapidly developing mineral industry. Also it was becoming more deeply involved in the maintenance of a working liaison between numerous federal and provincial authorities sharing responsibilities in geological and related matters. This liaison came to include formal notification each year to the provinces of the nature of, and detailed description of, field operations contemplated by the Geological Survey.

A quick backward glance at this stage was sufficient to reveal the extent of the progress made. In 1843, in the first active full year of its history the Survey consisted of its director, Logan, and one geologist, Murray. By the field season of 1923, eighty years later, the staff of the organization totalled 94 persons. Another example of its growth is found in the realm of photography. From the production of pioneer Canadian photographs made during a field trip in 1860 by James Richardson of the Geological Survey, that organization's collection of photographs had expanded to a total of 56,000, covering a remarkable range of topics and containing many original pictures rich in historical interest and value.

The relentless expansion of demands upon the Geological Survey in post-war years was reflected in the increase in the number of its field parties from 39 in the 1922 season to 47 two years later and to 54 in the season of 1925. This latter level of activity was maintained, on the whole, until the onset of the world-wide economic depression. During the 1920s about two-thirds of all parties in the field were carrying out geological investigation work. Other groups performed various related functions including exploratory activities and surveys preliminary to the construction of topographic maps.

In 1921, a peak year in the production of maps by the Geological Survey, Senécal reported a total of 79 maps published, 15 in the hands of the King's Printers, and 34 others in various stages of compilation. Subsequently the annual output of maps by this organization settled down to a level of about 20 sheets. Among those of special significance being compiled in the 1920s was the copper-engraved, 8-mile-to-the-inch, Lake

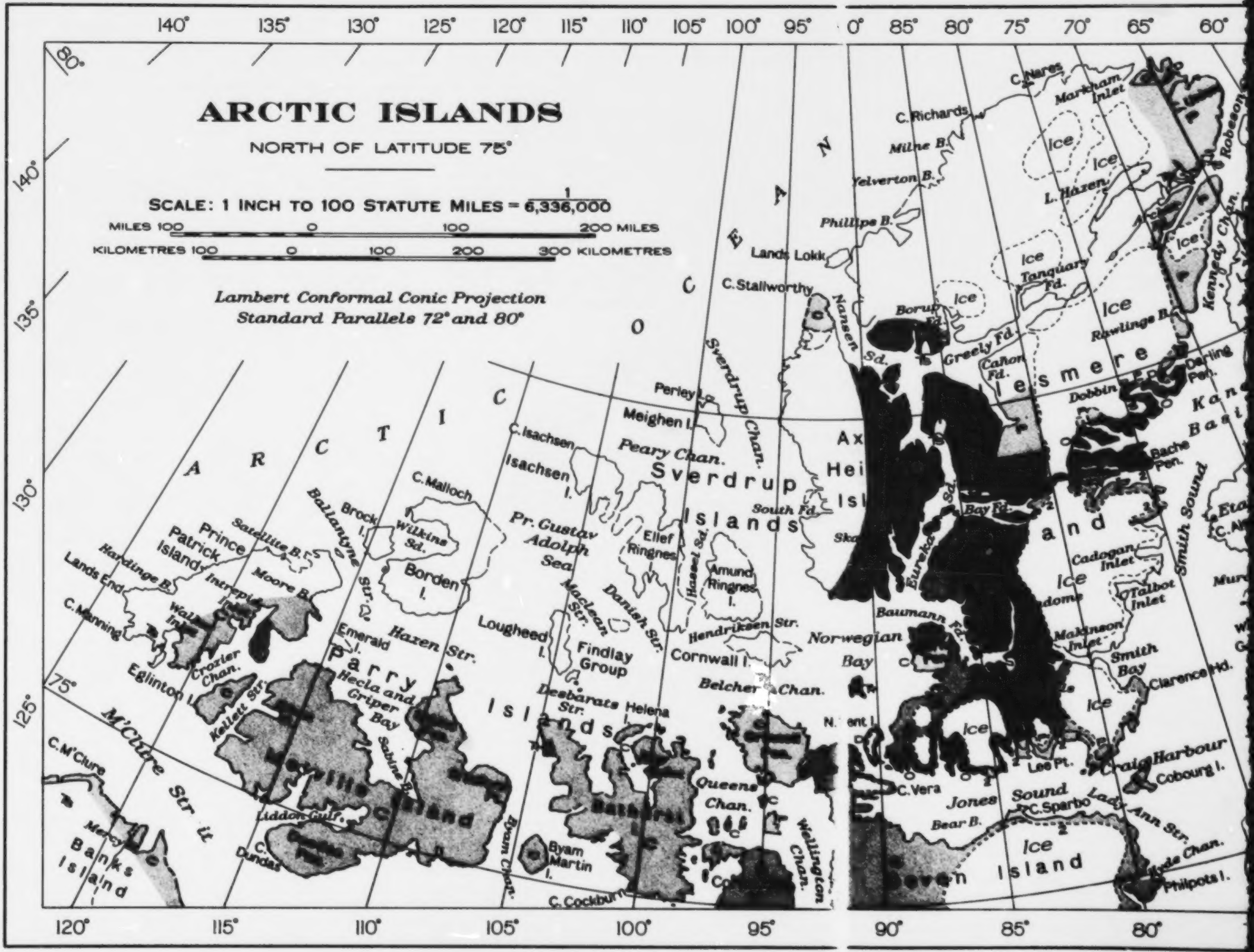
Huron sheet, issued in 1933. This geological map, now out of print, depicted an area from the Ontario-Quebec boundary westward to Lake Superior and extended from Lake Huron northward to latitude 50° North, covering about 90,000 square miles. Another geological map of prime importance in this series was the Nottaway sheet (Quebec Province), published in 1927, depicting the northwestern part of that province adjacent to the area portrayed by the Lake Huron sheet. The Nottaway map represented an area of about 140,000 square miles, extending between latitudes 48° North and 52° North, and from near Lake St. John on the east to the Quebec-Ontario boundary on the west.[7]

Collins, in his annual report for 1926-27 observed that since 1842 the Geological Survey had issued regularly reports and maps and that its total cartographic output during that period exceeded 1,000 maps. There was mention in the department's reports of the cooperation of the Royal Canadian Air Force during the 1926 field season in the task of completing approximately 4,000 square miles of vertical photography in the Rouyn mining district of Quebec. These photographs were produced to be used by the Geological Survey organization as well as by the Topographical Survey Branch, Department of the Interior, in the preparation of maps for publication. It was observed that the photographs afforded a more accurate delineation of rocky areas and drift-covered areas than had been possible otherwise, a distinction of much practical value to prospectors.

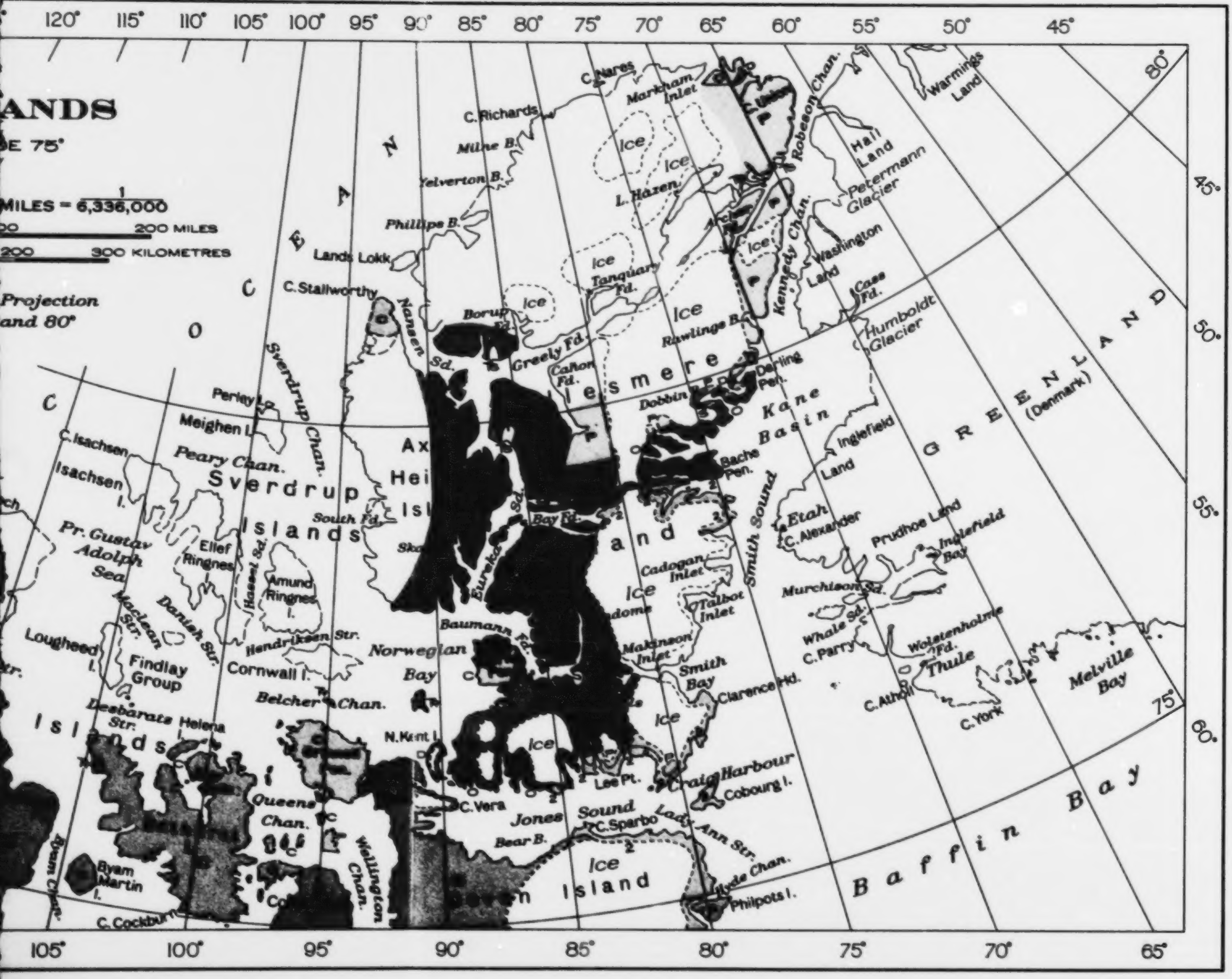
In 1926 Senécal was promoted and given the title "Geographer".[8] Dickison succeeded him as Chief Map Draughtsman and in the annual report of the Department of Mines for that year Senécal and Dickison began to issue, jointly, annual work summaries on behalf of the Geographical and Draughting Division. Robert Veitch remained in charge of the Map Engraving Division. "Mapping and map publication", Senécal and Dickison reported, "constitute an important phase of the work of the Geological Survey . . . reports and bulletins are illustrated by maps, plans, and diagrams. As well, separate topographical sheets are published for distribution." In the year following this innovation, the two divisions were merged to form the Geographical, Draughting and Engraving Division. A year later, 1922, Senécal's work entitled *Transverse Polyconic Projection for General Maps of Canada* was published as a Museum Bulletin. After 41 years of uninterrupted and distinguished service with the Geological Survey, Senécal retired on August 24, 1931. He had succeeded James White in 1899 as Chief Draughtsman, Department of the Interior. Senécal made a number of highly useful contributions to the advancement of cartography in this country, including the development by him of a process of color lithography used in printing Canadian geological maps of the period. For many years he was a highly valued member of the Geographical Board of Canada.

By 1927 Alexander Dickison (1880-1957) had been made chief of the Draughting and Reproducing Division in succession to Senécal. Dickison began his training as an apprentice map draughtsman at John Bartholomew and Son, the world-famous mapmaking firm in Edinburgh, Dickison's birthplace. Following war service with the Royal Scots in South Africa, Dickison returned to Bartholomew's and completed his training. After association for a time with the topographical section of the intelligence division of the War Office in London, Dickison came to Canada in 1905. In May of that year he was appointed to the staff of the Geological Survey, Ottawa, as a map draughtsman.

A tall, wide-shouldered, splendidly built man, Dickison was very much the perfectionist in his work. His qualities of leadership, including a firm belief in strong discipline, soon became apparent. By 1912 his name began to appear in the regular published annual reports of the Survey and by 1919 he had been made Supervisor of Map


ARCTIC ISLANDS
NORTH OF LATITUDE 75°
SCALE: 1 INCH TO 100 STATUTE MILES = 1/6,336,000
MILES 100 0 100 200 MILES
KILOMETRES 100 0 100 200 300 KILOMETRES
Lambert Conformal Conic Projection
Standard Parallels 72° and 80°
ARCTIC OCEAN
Sverdrup Islands
Parry Islands
Ellesmere Island
Axel Heiberg Island
Melville Island
Bathurst
Banks Island
Devon Island
Prince Patrick Island
Borden I.
Brock I.
Isachsen I.
Meighen I.
Ellef Ringnes
Amund Ringnes I.
Lougheed I.
Findlay Group
Cornwall I.
Emerald I.
Eglinton I.
Byam Martin I.
Helena
Cobourg I.
Philpots I.
C. Nares
C. Richards
Milne B.
Yelverton B.
Phillips B.
Lands Lokk
C. Stallworthy
Markham Inlet
L. Hazen
Tanquary Fd.
Greely Fd.
Cañon Fd.
Borup Fd.
Nansen Sd.
Rawlings B.
Dobbin B.
Darling Pen.
Bache Pen.
Kane Basin
Kennedy Chan.
Robeson
Smith Sound
Cadogan Inlet
Talbot Inlet
Makinson Inlet
Smith Bay
Clarence Hd.
Craig Harbour
Lee Pt.
C. Vera
C. Sparbo
Bear B.
Jones Sound
Lady Ann Str.
Hyde Chan.
Ice
Bay Fd.
Eureka Sd.
Baumann Fd.
Norwegian Bay
Belcher Chan.
Hendriksen Str.
Queens Chan.
Wellington Chan.
Perley I.
Peary Chan.
Sverdrup Chan.
South Fd.
C. Isachsen
C. Malloch
Wilkins Sd.
Pr. Gustav Adolph Sea
Hassel Sd.
Danish Str.
Maclean Str.
Ballantyne Str.
Hazen Str.
Desbarats Str.
Byam Chan.
C. Cockburn
Satellite B.
Moore B.
Intrepid Inlet
Walker Inlet
Hardinge B.
Lands End
C. Manning
Crozier Chan.
Kellett Str.
Hecla and Griper Bay
Sabine B.
Liddon Gulf
Dundas Pen.
C. Dundas
M'Clure Strait
C. M'Clure
Mercy B.
140° 135° 130° 125° 120° 115° 110° 105° 100° 95° 90° 85° 80° 75° 70° 65° 60°
80° 75°

MAP 11. Arctic Islands, inset shown on geological map of Canada, Map 820A, published in Ottawa, 1945.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E 75°
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C. Nares
Markham Inlet
C. Union
Robeson Chan.
Warmings Land
C. Richards
Milne B.
Ice
Ice
Hall Land
Petermann Glacier
Yelverton B.
L. Hazen
Phillips B.
Archer Fd.
Ice
Kennedy Chan.
Washington Land
Lands Lokk
Ice
Tanquary Fd.
C. Stallworthy
Cass Fd.
Nansen Sd.
Ice
Borup Fd.
Ice
Rawlings B.
Humboldt Glacier
Sverdrup Chan.
Greely Fd.
Cañon Fd.
Darling Pen.
O C E A N
C
Perley I.
Ellesmere
Dobbin B.
Kane Basin
GREENLAND (Denmark)
Meighen I.
Axel Heiberg Island
Inglefield Land
Bache Pen.
C. Isachsen
Peary Chan.
Isachsen I.
Sverdrup Islands
South Fd.
Eureka Sd.
Bay Fd.
Island
Smith Sound
Etah
C. Alexander
Prudhoe Land
Inglefield Bay
Pr. Gustav Adolph Sea
Ellef Ringnes I.
Hassel Sd.
Amund Ringnes I.
Cadogan Inlet
Ice
Talbot Inlet
Murchison Sd.
Maclean Str.
Danish Str.
Baumann Fd.
Whale Sd.
C. Parry
Wolstenholme Fd.
Thule
Melville Bay
Lougheed I.
Findlay Group
Hendriksen Str.
Norwegian Bay
Makinson Inlet
Smith Bay
Clarence Hd.
C. Atholl
C. York
Cornwall I.
Belcher Chan.
Ice
Desbarats Str.
Helena I.
Islands
N. Kent I.
Ice
Craig Harbour
Coboung I.
Lee Pt.
Queens Chan.
C. Vera
Jones Sound
C. Sparbo
Lady Ann Str.
Baffin Bay
Wellington Chan.
Bear B.
Ice
Byam Martin I.
Byam Chan.
Devon Island
Hyde Chan.
Philpots I.
C. Cockburn

MAP 11. Arctic Islands, inset shown on geological map of Canada, Map 820A, published in Ottawa, 1945.

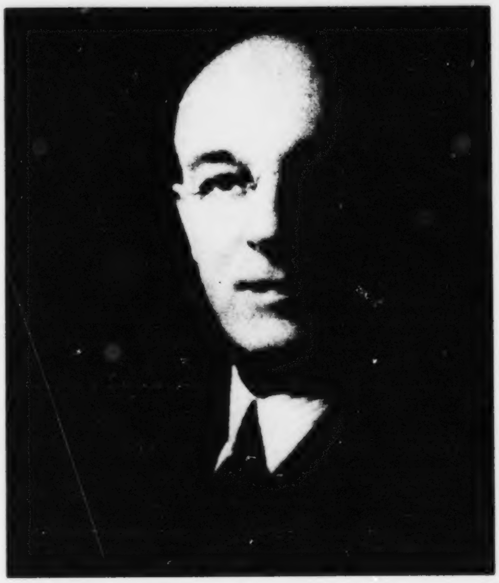

FIGURE 132. Alexander Dickison.

Preparation and Reproduction. In January, 1930, he succeeded Senécal on the Geographic Board of Canada and, in time, became its chairman. By 1936 he was in charge of a staff of 34 skilled craftsmen in the employ of the Geological Survey.

When Dickison retired in 1945 his office associates presented him with a framed, illuminated message expressing admiration "of your accomplishments in the pursuit of your ideals for geological and topographical mapping to the desired perfection, culminating in the production of the Geological Map of Canada." Dickison took special pride in this cartographic accomplishment which he regarded as the crowning achievement of his forty years in the federal civil service. It was published in 1945 as Map 820A in the catalogue of the Geological Survey. This monumental production was issued in an east sheet and a west sheet, the scale being 60 miles to the inch. It is unique as a Canadian-made map in as much as, for the first time, the Arctic islands were included separately in an inset on the same projection as the mainland of Canada (Lambert Conformal Conical) so that the distortion of our northern territories that normally occurs was eliminated to a marked extent. The region portrayed in the inset was drawn on the basis of its own two standard parallels. S. C. McLean, a topographical engineer and expert in the application of projections to mapping problems, gave valuable assistance in the drawing of this remarkable map.

The year 1935 was an epochal one for the Geological Survey. Parliament was asked by the federal government to vote a very substantial increase to the Survey for its field work program in that year. The legislators were quick to respond to the opportunity and this favorable development brought about a considerable expansion of activity both in the field and in the acquisition of new equipment. The rather abrupt revival in the fortunes of the organization was partly the result of a government effort to enlarge employment opportunities in Canada in a useful, constructive manner. Included among more than 1,000 direct beneficiaries of this expansive policy in the 1935 season were a number of geological and mining students then attending Canadian universities. In all, 188 parties were placed in the field by the Geological Survey on 65 separate projects.

This activity was largely concentrated in gold-producing, petroleum, natural gas and asbestos areas.

Collins retired as Director of the Geological Survey in 1936 and was succeeded by George Albert Young, who served as Chief Geologist until 1943.

FIGURE 133. G. A. Young.

At this stage in its progress a Bureau of Economic Geology was formed with Francis Christopher Chisholm Lynch (1884-1963) in charge. Lynch had entered the federal civil service in 1906, joining the Department of the Interior under Robert Evans Young, a land surveyor of eminence in western Canada who had been appointed superintendent of the Railway and Swamp Lands Branch of that department. Lynch soon became assistant superintendent of the branch and, at the age of 27, succeeded Young in 1911. About 1915 the Department of the Interior created the Natural Resources Development Bureau. Five years later this organization was renamed the National Development Board. In each case Lynch was in charge.

Following the transfer of natural resources from Canada to the western provinces in 1930 the National Development Board was disbanded. By 1934 Lynch was in charge, actually as well as nominally, of the Bureau of Economic Geology in the Department of Mines. This bureau was one formed to promote public awareness of the benefits flowing to the nation as a whole from geological work. In the language of the annual report of the department at the time the move was described as "a reorganization of the Geological Survey effected to develop a more fully coordinated machine in the Survey to hasten the publication of maps and reports as well as to give them a more practical character, and generally to intensify the services of the department to the industry."[9]

In 1936 the Department of the Interior disappeared as such and much of its work was carried on by the newly-created Department of Mines and Resources. The Mines and Geology Branch of the new department consisted of the Bureau of Mines, headed by W. B. Timm, and the Bureau of Geology and Topography with Lynch in charge. The latter organization consisted of four divisions, Geological Survey, Topographical Survey, Map Draughting and Reproducing, and Development. Later the National Museum of Canada became a division.

Under the new dispensation within the Bureau the language of annual reports relating to the work of geologists began to appear less technical. "The Geological Survey", according to the Bureau's 1935-36 report, "explores and maps known and potential mineral-bearing regions and ascertains the nature, extent and mineral possibilities of the rocks. From the results of this work the prospector learns where, and where not, to conduct his search . . . Close cooperation is maintained by the Geological Survey with provincial and federal departments in order that field investigations and geological knowledge thereby acquired may be properly coordinated to the greatest benefit of the mining industry.

"The range of the prospector's activities has been greatly extended by reason of the airplane and, as a consequence, an urgent demand for topographic and geologic maps has arisen. The facilities of the Bureau have been strained to cope with this demand but thanks also to the use of the airplane in aerial surveys and the modern science of map making, the prospector has had the satisfaction of obtaining maps of a number of areas that were formerly almost inaccessible." That year the Bureau distributed among the public more than 64,000 map sheets and other publications, a marked increase over the corresponding total for the previous 12-month period.

At this stage a Bureau policy was adopted of issuing preliminary reports and maps shortly after geologists returned to Ottawa from the field so that results of field work would be made available to prospectors at the earliest possible date. These publications replaced Summary Reports that had been issued collectively once each year. In the 1936 summer season 48 geological parties operated in the field. A total of 44 separate maps was published in that year while 67 other map sheets were in various stages of preparation for printing.

Early in 1937 Dr. W. H. Collins died. He had become an authority on North American Precambrian geology and had made an outstanding contribution to geological literature in his studies of the Sudbury nickel-copper deposits. His 16-year term of office as head of the Geological Survey was exceeded in length only by those of Logan and Selwyn. Under Collins the National Air Photographic Library had expanded swiftly and by the time of his retirement nearly 700,000 photographs were on file in that institution.*

The demand for minerals and mineral products suddenly became acute following the outbreak of the Second World War. As hostilities intensified the appetite of the allied powers for strategic minerals, more than ever essential as tools of war in the fight for freedom, proved insatiable. The Geological Survey became responsible for the conduct of intensive surveys of known producing areas and of prospective deposits in Canada. These strategic minerals included graphite, fluorspar, potash, manganese, tungsten and brucite. Tin-bearing deposits in the Yukon, Northwest Territories and Manitoba were also investigated. But this type of activity formed only one aspect of the Geological

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*In 1956, for the first time in formal annual reports of departments the title appears as *National Air Photo Library* although in actual office practice this abbreviated version of the original name was used much earlier.

Survey's wartime program. For a period during the conflict the primary need in this country was to expand Canadian production of gold in order to provide the nation with essential foreign credits. Then the task of supplying large quantities of alloying metals became critically important. In turn this project was followed by an energetic search for new sources within Canada of crude petroleum. Geological structures in the foothills of Alberta, favorable to the accumulation of oil and natural gas, were studied and mapped. Oil production possibilities of a part of the Peace River district, involving air and ground surveys, were also investigated at the request of the Oil Controller for Canada, a wartime official.

Not all the bullet-dodging in the years of world conflict occurred in theatres of war. The experience of A. C. Tuttle during the field season of 1939 is evidence of the unusual hazards faced by topographical surveyors in the course of their work. In that season Tuttle had been engaged in the preparation of base maps of the McQuesten and Mayo areas of the Yukon for use by the Geological Survey. He had crossed the Stewart River and reached the shores of Minto Lake. There he discovered an old cabin but could not find the occupant. Continuing on his way Tuttle walked along a few steps ahead of his cook, both men being followed by their horses. In the meanwhile the occupant of the aforesaid cabin, absorbed in hunting moose, approached along the same trail from the opposite direction. Hearing the sound of horses' hooves the hunter concluded that a moose was near and so raised his rifle to the ready. As Tuttle came into view rather suddenly around a bend in the trail he caught sight of the glint of sunlight on a gun barrel about 100 yards distant. Immediately the surveyor called out loudly and leapt to one side, his cook acting in unison. At that moment the gun was fired and a horse behind the men was killed. Later the hunter claimed that he had mistaken Tuttle's drab shirt for a moose!

In the 1942 season 28 geological parties and 18 topographical survey parties were active in the field. Some 130 maps were published by or through the Draughting and Reproducing Division, including a geological map of southern Quebec Province, issued in three sheets on a scale of 12 miles to the inch. The 1942 season marked the completion by the Geological Survey, the oldest of all federal government scientific services, of 100 years of continuous, constructive activity. To mark this historic accomplishment the Geological Society of America accepted an invitation extended by the government of Canada to hold its 1942 annual meeting in Ottawa. Pressures due to war conditions led to a cancellation of this planned event. But the Canadian achievement did not go unrecognized. Dr. J. B. Tyrrell, formerly of the Geological Survey, presented to the organization a case containing medals and badges won by Sir William Logan, its first director. These included the Gold Medal awarded him by the 1851 London Exhibition, England; the Grand Gold Medal of Honour from the 1855 Paris Exposition; the Wollaston and Royal Medals from the Geological Society of London, England, and badges of the Chevalier and Officer of the Legion of Honour of France. In 1947 proper anniversary amends were made when the Geological Society of America met in Ottawa to observe the 105th birthday of the Geological Survey of Canada as well as the 60th anniversary of its own formation. Nearly 2,000 scientists attended.

For some time prior to the end of hostilities in Europe matters of post-war concern and policy were receiving increasing attention from those in charge of Geological Survey affairs at Ottawa. W. B. Timm reported on the nature of steps that were then under consideration by which its services might be extended to help meet the anticipated peacetime expansion of resources development programs. Plans were revealed that involved an increase of Geological Survey staff, within the space of a few years, to three times its wartime size.[10]

In 1944 Dr. George Hanson, by now Chief Geologist, warned about the immensity of the task facing Canadians in attempting to complete the geological mapping of the nation. In 1936, soon after he had completed his investigations and mapping of parts of British Columbia, mainly from Portland Canal to Babine Lake as well as in the Cariboo and McDame Creek areas, Hanson had been made assistant chief geologist in the federal organization, rising to this senior post in the Survey seven years later. Not long after this latter promotion Hanson wrote that "presently the proportion of Canada mapped adequately for purposes of the Geological Survey is 11 per cent. Mapping by provincial organizations has been mainly detailed and will not probably increase the total by one per cent . . . If it has taken 100 years to cover 11 per cent of Canada, at this rate it will take 800 years to map the other 89 per cent . . . the present staff cannot meet all present demands for detailed investigations and, even cutting some of the less promising of them, few of the staff can be assigned to systematic mapping of the unmapped part of Canada . . ."[11]

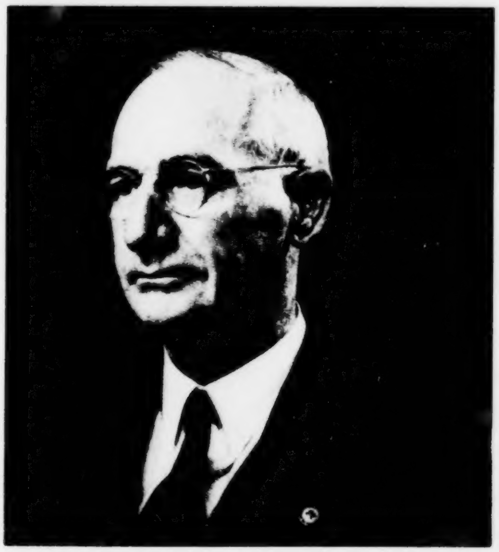

FIGURE 134. George Hanson.

About this time the geological mapping and other field activities of two promising young members of the Survey staff were attracting favorable attention. In the course of events, and in succession, both became directors of the Geological Survey of Canada. James Merritt Harrison (1915-) was particularly active in the gold and base metal areas of northern Manitoba. Yves Oscar Fortier (1914-) made flights with the magnetic survey party of the Dominion Observatory over Arctic islands and adjacent mainland regions, involving continuous observations of bedrock geology, topographic forms, and land emergences. Fortier later became the first to recognize the oil-bearing potential of the Arctic islands.[12]

Clifford Symington Lord (1908-), who rose to the post of Chief Geologist of the Geological Survey of Canada, conducted important field work in the early 1940s in northern British Columbia and the territories, including a geological reconnaissance along the Alaska Highway between Watson Lake and Teslin River. As a result of lessons learned in the Northwest Territories in the late 1940s he later introduced the helicopter as a means of greatly accelerating geological surveys.

Direct participation by the Geological Survey in federal operations in the atomic energy field began in 1944 when the Eldorado Crown Company acquired the assets of the Eldorado Gold Mining Company. But prior to that year the Survey had made highly important if indirect contributions to the discovery of radioactive minerals in this country. In 1900, for example, an exploratory geological survey party reported an occurrence of cobalt on the east shore of Great Bear Lake. Thirty years later Gilbert LaBine was led by that report to visit the locality. In addition to finding silver, for which he was searching initially, LaBine discovered pitchblende. This find, in turn, brought about the establishment of Eldorado Mine, a world-famous source of uranium. Following the LaBine discovery the Geological Survey made several geological maps in that general region and these proved very useful when uranium production became the centre of official and public interest.

In the development of Canadian sources of uranium Dr. W. H. Collins made an important pioneer contribution. His Blind River sheet (No. 1970, Memoir 143), published in 1925, was a map of the geology of that region that provided major assistance in the staking and subsequent production of the Blind River (uranium) camp. Collins, in the prime of his life, was a tall, lean, muscular type. He was a good packer in the field and an excellent canoeman. His mapping of regions over which he travelled was outstanding. During the whole of his professional life it was his ambition to make the Geological Survey, which he came to head, of special value to his country. With the extension of geological mapping to districts other than Great Bear Lake, prospectors attached to some of the field parties in the Lake Athabasca area uncovered many indications of uranium. These finds, in turn, led to the rapid development of that field. In the ten years following 1944 the Survey produced 19 geological maps of the major uranium districts of Canada.

At the time of Dickison's retirement in 1945 two members of his staff were equally in line, in terms of ability and experience, to succeed him as chief of the draughting division. These men were Arthur Joanes and S. G. Alexander. Joanes won the appointment because of seniority in age and his proximity to automatic retirement. After about two years in that position he was succeeded by Stanley Gordon Alexander. Like Dickison, Alexander had received early training in his craft with the Bartholomew firm of Edinburgh. In 1910, following his arrival in Canada, Alexander joined the Geological Survey staff under Senécal. Enlisting in the Canadian Army in the First World War Alexander saw active service overseas, his military career culminating in his attachment to the staff of Brigadier General McNaughton as a reconnaissance officer. Returning to his work in Ottawa on the conclusion of hostilities Alexander rounded out his lengthy term of service with the Geological Survey's Map Draughting Division as its chief from 1947 until his retirement in 1955. Two men who had been trained under Dickison succeeded Alexander in turn, namely, Arthur E. Hale and Gordon Stephen Daughtry.

Without fanfare of any kind 15 men gathered in Ottawa soon after the conclusion of the Second World War in a meeting the conclusions of which had a highly important influence on the post-war future of Canadian surveying and mapping. The meeting was held in the afternoon of December 17, 1945, in the Council Chamber of the National Research Council. The gathering was composed, for the most part, of surveyors prominent in the federal government service. K. G. Chipman, who had succeeded Boyd as Chief Topographical Engineer, and G. W. H. Norman of the Geological Survey were in attendance. Those present discussed the application of radar to survey work and the meeting learned that two Canadian Army officers, Major J. I. Thompson and Major L. Trorey had recently joined the staff of the Directorate of Operational Research (Army). These officers, it was made known, were available to carry on any desired experimental work that the committee might consider of value. The unanimous decision of that meeting to make use of the special experience of Thompson and Trorey marked the beginning of a new era in surveying and mapping in this country, including the adoption of the highly useful application of the shoran principle.

In the reorganization of the Department of Mines and Resources in November, 1947, the Bureau of Geology and Topography lost one of its three divisions, namely, the Topographical Survey, to a newly-formed Surveys and Mapping Bureau. This latter agency had been established within the Mines, Forests and Scientific Services Branch of the Department of Mines and Resources. This reorganization involved the *physical* separation of topographical surveyors from the Geological Survey of Canada through a transfer of such mappers from the National Museum building in Ottawa to No. 8 Temporary Building in the same city.

In effect, however, the *actual* separation had occurred at the time that the Department of the Interior, as such, passed out of existence in 1936. When the Department of Mines and Resources was formed to take over the Interior Department's functions a merger of nearly all civilian topographical surveyors in the federal government service was brought about. A number of these men, employed in the Air Survey Section under R. B. McKay, moved from the Labelle Building in downtown Ottawa to the National Museum Building, along with a few men not directly associated with the work of that section. All these joined Boyd's staff, operating within the Bureau of Geology and Topography. At this time, therefore, the responsibility for the activities of civilian topographical surveying in Canada was vested in the Chief Topographical Engineer.[13] Division chief Boyd summoned all members of the expanded organization to a meeting partly for the purpose of welcoming newcomers to his staff. "From now on", he declared, "you are the Topographical Survey of Canada." His statement carried the implication that henceforth the new unit was no longer limited to topographical surveying work for the Geological Survey but that it would be responsible for most, if not all, topographical surveying in this country. In other words, the T.S.G.S. had been superseded by the T.S. of C. (The term "Topographical Survey *of Canada*" was used as a unit description by the Department of the Interior in its annual reports from 1922 to 1925 only.)

Following the administrative rearrangements of 1936 some topographical surveyors remained under the Surveyor General of Canada as part of the Hydrographic and Map Service, an organization within the Surveys and Engineering Branch of Mines and Resources. Members of this staff compiled electoral maps, air navigation charts, railway maps, natural resources maps as well as general maps of Canada, mostly derived from existing base maps or maps already published. Generally their cartographic functions were exercised in the interests of *production*, the issue of sheets in printed form, whereas Boyd's staff was active on topographic field surveys and in the preparation of map manuscripts up to the final draughting stage. By 1946 the Hydrographic and Map Service had become the largest single producer of map sheets in Canada. By 1950 that

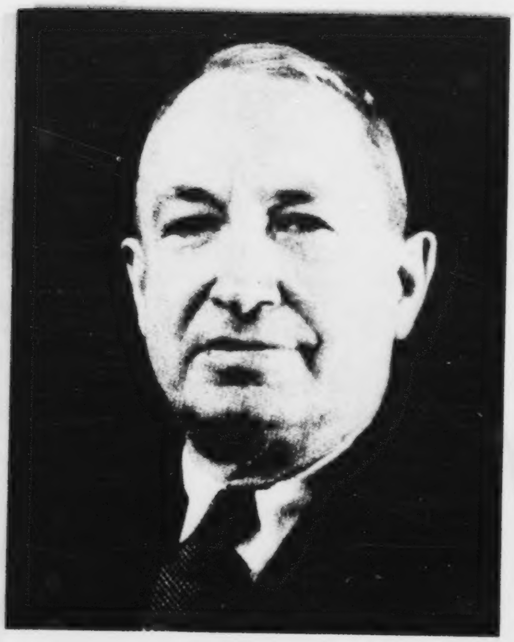

FIGURE 135. R. B. McKay.

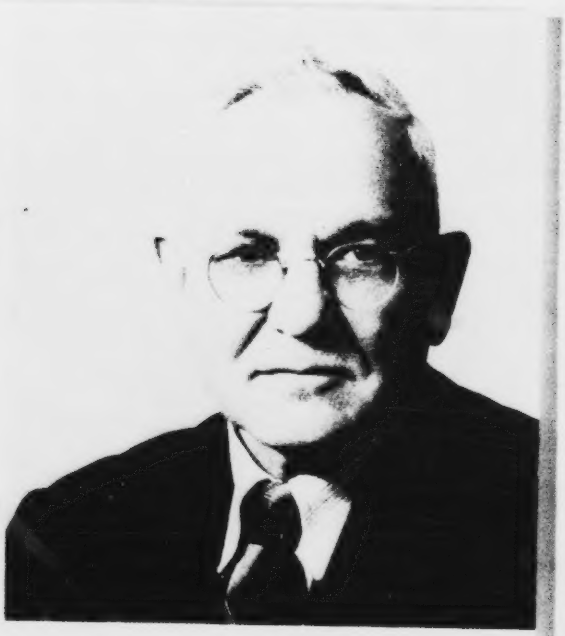

FIGURE 136. G. S. Hume.

Service had been absorbed, along with all of Boyd's staff, in the Surveys and Mapping Branch, Department of Mines and Technical Surveys.

In 1947 Lynch retired as chief of the Bureau of Geology and Topography and was succeeded by Dr. G. S. Hume. Lynch's career in the public service of Canada had extended over more than 40 years. For a number of years he carried on the duties of secretary-treasurer of the Ottawa Branch, Engineering Institute of Canada.

The Geological Survey *of Canada*, with Dr. Hume as its chief, embarked on a new stage of development. In its official annual reports and in its 105th anniversary year the organization resumed use of the full title under which it had been so widely and favorably known during the first 65 years of its career. With Dr. Walter Andrew Bell (1889-1969) as its *director*, the Geological Survey of Canada became a full-fledged branch in the Department of Mines and Technical Surveys.

During three decades in which Canada was affected by two world wars and a severe economic depression, geological mapping continued to expand and advance in this country. Nowhere in the western world in this disruptive period were there more challenging opportunities for mappers and map makers than in this vast country, slowly awakening to its tremendous possibilities. Under such men as Senécal, Lynch, Dickison and Veitch the compilation and production of high-quality maps kept pace with the lively output of field work of the Geological Survey across a span of years extending from about the beginning of the motor age to the dawn of the atomic age.

In Canada, as in the rest of the world, maps are indispensable to orderly, effective geological study and research. "The geological map", in the words of an impressive tribute to this form of cartography, published in 1928, "is an index of the extent and accuracy of geological knowledge at the time of its production and is also the basis of future research. It is the vehicle by which men communicate to one another their discoveries relating to the nature and arrangement of the rocks of the earth's crust and it makes possible the prosecution of further research covering the distribution of rocks, their origin and the evidence of the life of the past which they may contain . . . The geological map may, therefore, be regarded as the dynamic force in geology."[14]

16

MAJOR CHURCH'S SURVEY SCHOOL

In all seasons of the year the people who live in or near Lawrencetown, in famed Annapolis Valley, have become accustomed to the sight of youthful surveyors busy near highways, along the Dominion Atlantic Railway line, and in the fields bordering the community. The instrumentmen and rodmen are readily recognized as surveyors-in-training at the Nova Scotia Land Survey Institute. This happens to be the only vocational school in Canada bearing the description "Land Survey" in its title and *solely* devoted to the training of surveyors, photogrammetrists, and cartographic draughtsmen. The story of the beginnings of this unique institution and of the indispensable part played in its founding by its first chief instructor is a record of exceptional dedication, perseverance and vision.

In 1941 the federal government asked authorities at the Nova Scotia Technical College, Halifax, to establish a program under which army personnel could be taught to function as military surveyors. This attempt failed when it was found that suitable instructors for such courses were unavailable. Two years later a second attempt in this direction proved successful.

Major James Archibald Hepburn Church, D.S.O., M.C., P.L.S. (1883-1967), a veteran of the First World War, had been born in 1883 in India of Scottish parents, William and Marian Church. Graduating from a grammar school in England in 1902 young Church served five years of apprenticeship with a Glasgow mining and engineering firm. Five years later he emigrated to Canada where, in British Columbia and Alberta, he engaged in mining engineering. In August, 1914, at Edmonton, Church enlisted in the 19th Alberta Dragoons and travelled overseas with that unit. Later he was transferred to the 251st Tunnelling Company of the Royal Engineers and for gallantry in action was awarded the Distinguished Service Order and the Military Cross. In 1919 he returned to western Canada and resumed activity there as a mining engineer. In 1931, at the age of 47, Major Church retired from his profession to become a gentleman farmer in Nova Scotia on the fringe of Lawrencetown. The province and locality were selected by Major and Mrs. Church partly because land in the area was somewhat less expensive at the time than land elsewhere in Canada, partly because the major believed that this district of the Annapolis Valley, on the average, enjoyed more hours of sunshine per year than any other district of Nova Scotia.

Coincidence sometimes plays a critically important, if somewhat peculiar, part in the creation and subsequent success of an institution. In this instance its role is particularly remarkable. Three years prior to the arrival of the Alberta couple seeking retirement at Lawrencetown, a local resident had died and left a large, unusual bequest of a capital sum approaching $100,000 "for the founding of a Vocational School in the County of Annapolis." In addition, under terms of the will, provision was made for the application of the annual proceeds from investment of certain other funds "towards the support, maintenance and operation of the said Vocational School." At the time of arrival in their new home Major and Mrs. Church were quite unaware of the bequest. The public-spirited donor, a native of Lawrencetown, was James Barclay Hall (1843-1928), a doctor of philosophy and a principal of the Normal School at Truro. So once again, in that tangled skein of circumstances known as history, the financial substance of

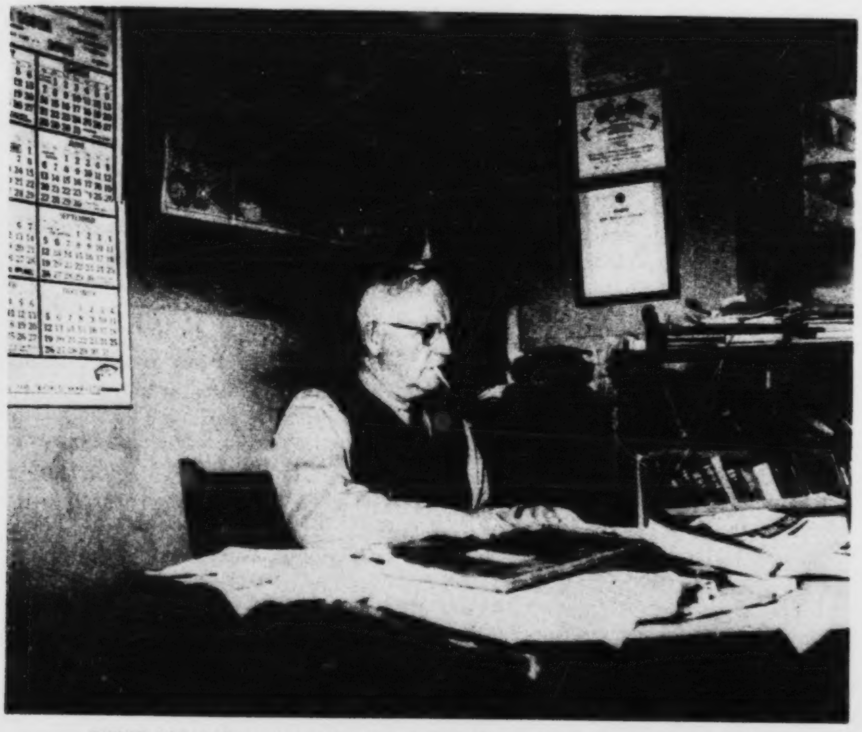

FIGURE 137. Major J. A. H. Church at his desk, Survey School, Lawrencetown, 1954.

one eminent man and the special qualities and abilities of another were joined for effective action, apparently by pure happenstance. In this small Nova Scotian community the combination brought into being a school capable of maintaining a steady flow of men and women graduates into the mainstream of Canadian life, trained in the basic theory and practice of surveying and mapping.[1]

In 1943, the year in which he was commissioned a Provincial land surveyor, Major Church was summoned to serve at Halifax and at nearby Camp Aldershot as a civilian instructor in topographical survey work. In that same year he was requested by the Department of National Defence to organize No. 6 (Army) Vocational Training School, Surveyors Class, at Nova Scotia Technical College so that potential surveyors in the armed forces could be given some training in the craft.[2] At the end of the war one of the classes in land surveying had reached only the half-way point in the required course. In accordance with general instructions governing demobilization Major Church was ordered to terminate the educational venture that had been commenced so ambitiously under his direction. But those in authority failed to reckon with the tenacity, vision and vigor of the resourceful major who pointed out persistently that there was an obligation resting on military agencies to find employment for these trainees. "Why", he asked with considerable force and logic, "should the course be cancelled at the midway mark when this type of training fitted men for useful civilian careers?"

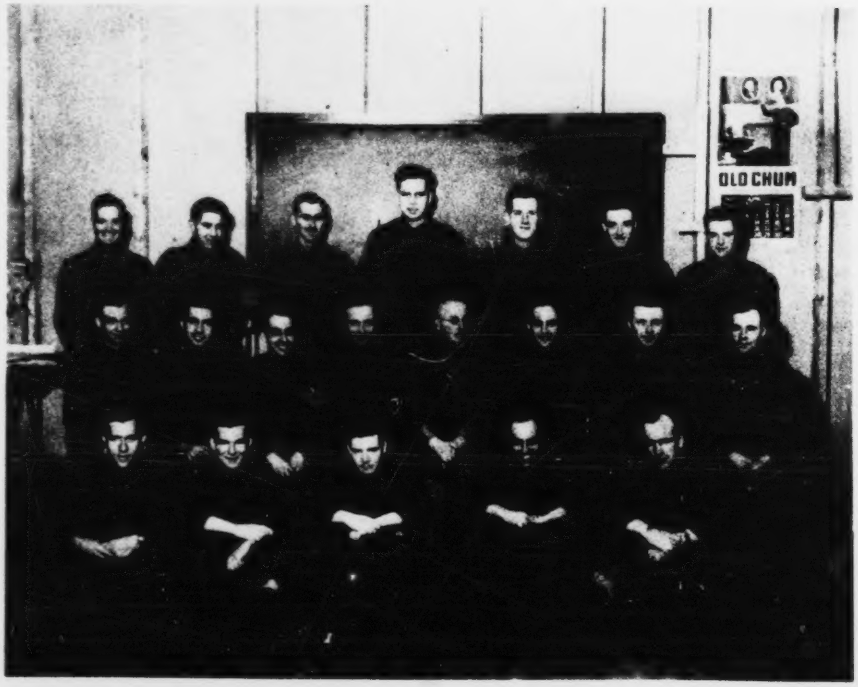

FIGURE 138. Surveyor's class, No. 6 Vocational Training School, Halifax, 1943.

At about this stage in post-war developments a government official, influential in the Maritimes, came to the rescue of the embattled major, strongly supporting him in his struggle to have the training project retained. Dr. F. H. Sexton, director of technical training for the Atlantic provinces, perceived the value of providing educational opportunities in land surveying for war veterans under the federal-provincial Vocational Training Program, administered and financed by the Department of Labour, Ottawa. A syllabus was submitted to government authorities in the maritime provinces in the hope that such a training course, extending over a period of 12 months, would be accepted as qualifying the graduate to sit for the Provincial Land Surveyor examinations in any of the three provinces.

The provinces by the sea approved the proposed syllabus as a basis of such eligibility although Prince Edward Island added a minor condition. Authorities in the island province felt that a graduate of the vocational training course should be required to serve three months with a Prince Edward Island surveyor before qualifying for a certificate to practise in that province.

When the new course was instituted on November 1, 1945, at Halifax the principal aim of those in charge was to develop surveyors who would be well and truly grounded in the requirements of the profession.[3] It was formally declared that not only should trainees gain facility in the use of instruments and in the techniques of surveying but should seek to build reputations for dependability and for the use of good judgment. It was not expected that expert practitioners would be produced in one year of schooling but the hope persisted that this type of student training would enable the trainee to learn from his own experience the limits of survey accuracy possible by use of the level, compass and chain.

The Department of Veteran Affairs moved into the picture and made this venture a rehabilitation training project for veterans of the Second World War. This action enabled those taking the course to receive $60 a month, as a cash grant, along with free tuition and books. When this federal department faded out of this sponsorship at the end of 1948 Major Church, undismayed, brought his special gifts of persuasion to bear upon the Department of Education of Nova Scotia. At this point the mystery of coincidence worked its peculiar magic. Major Church, by now aware of the Hall bequest, proposed to E. K. Ford, director of vocational training, Department of Education, that funds of the bequest be used to promote the advancement of the tiny, struggling 'School'.

During the first years of its development the school led a nomadic type of existence under the supervision, successively, of several provincial government departments. Hampered by lack of suitable open-field training conditions in the capital city, the project was moved from Halifax to Lawrencetown, partly because of the proximity of that site to the home of its chief instructor and partly because of the terms of the Hall bequest. Only temporary accommodation for the school could be found there at the time, however, and it was transferred to the upper floor of store premises in nearby Middleton, just six miles distant. When the branch of the Canadian Legion at Lawrencetown decided to donate property adjoining its hall in that community to accommodate a new Institute building, "Major Church's School" as it had come to be popularly known, returned to Lawrencetown.

In 1958 a great forward stride was taken in the progress of the project when the cramped, single-room Legion structure was replaced by a modern school building of steel, concrete and brick providing space for several large, well-lighted classrooms.* All

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*It was at this juncture that the Institute course was extended from one year to two years.

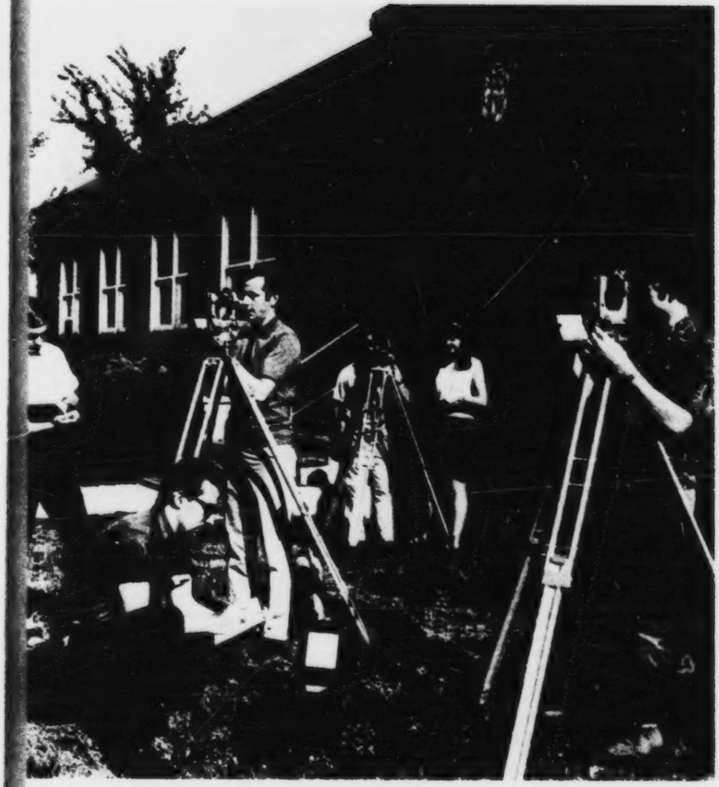

FIGURE 139
Nova Scotia Land Survey Institute building, Lawrencetown, erected 1958.

this had been made possible mainly by Dr. Hall's bequest. It was at this time that the project was christened "Nova Scotia Land Survey Institute". Major Church continued as chief instructor until 1961 when he was accorded the title of principal of the institution. However, all was not smooth sailing. Plans to base a cadastral survey of the town of Middleton on triangulation and graphic intersection points collapsed when authorities of that town refused the benefits of such a project. Despite this setback a levelling scheme was inaugurated, commencing at a geodetic bench mark located in Middleton and extending to Lawrencetown and return.

Field astronomy exercises also provided the average surveyor with formidable difficulties. It was discovered, however, that once a trainee had grasped the basic principles involved in the transition from plane to spherical trigonometry and had mastered the techniques of making solar and stellar observations with reasonable accuracy, his self-confidence and self-reliance grew remarkably. Field work was divided, naturally enough, into two main categories. The first of these involved retracing old boundary lines originally run by use of the magnetic compass. The second, a general practice course, included all types of surveying from bounding a town lot to a timber berth. When a job opportunity developed in the latter category the student attended the

Land Registry Office and searched the abstracts of title involved in the survey. Then he made his survey on the ground, completing his closure and compiling a complete and correct description of the property. Generally these student surveys were made by use of a transit. If there was any excessive amount of brushwood to be cleared, however, recourse was had to a magnetic compass. In each case the point of beginning of the survey was tied in to some topographical feature.

Ethical conduct in the practice of the profession, as taught at the school, was based upon the principle that a client was entitled to the best service that could be performed for him and that the surveyor, at all times, must carry out his tasks uninfluenced by friendships and unaffected by mercenary considerations. Major Church possessed a

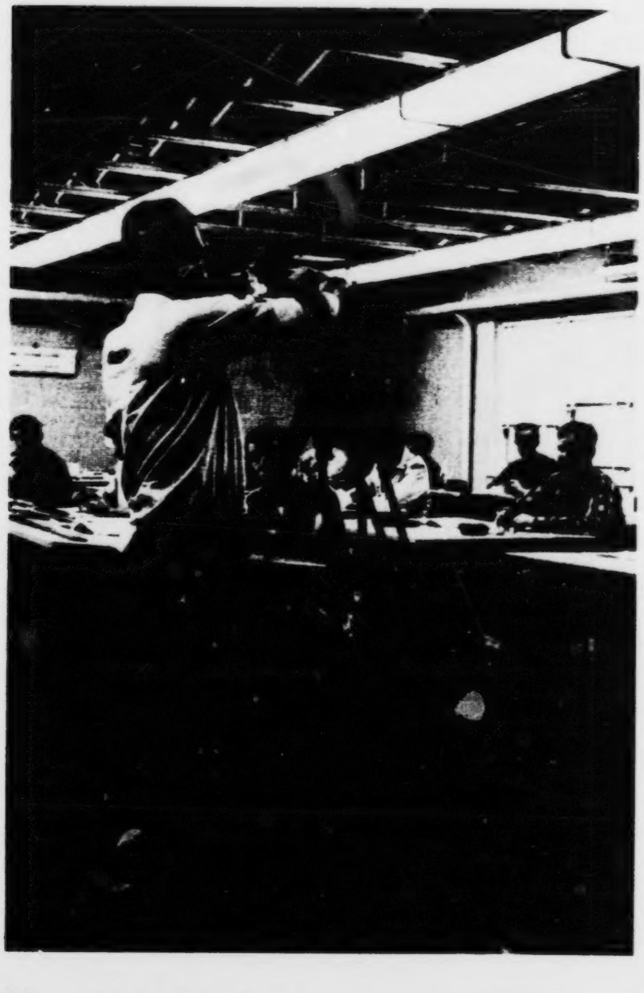

FIGURE 140
Instructor demonstrating theodolite in classroom, Nova Scotia Land Survey Institute.

profound sense of right and wrong and his standards of conduct were communicated effectively to his students by example as well as by precept. Ever forthright and often brusque in manner the major, nevertheless, won and retained the high respect of all officials with whom he had dealings and of those he taught. Major Church never yielded to pressures when he felt his just rights were in jeopardy. His fearlessness became a by-word. In negotiations he did not believe in the subtle diplomacy of "beating around the bush". On one memorable occasion, in a letter to a highly placed government official in which he indignantly complained about the quality of a certain instrument in the school's equipment, he wrote that the appliance was "about as useful as mammary glands on a boar pig".

Major Church was in the habit of bombarding the Nova Scotia Department of Education with proposals advocating the adoption of improved methods and facilities in the teaching of land surveying and related courses. Then, with the aid of the Association of Land Surveyors of Nova Scotia, he brought heavy guns to bear upon the provincial Department of Lands and Forests in an effort to bring about the establishment of higher entrance standards, and certification requirements in connection with these courses. He encouraged his students to strive for the highest possible attainments with the result that many of his graduates proceeded to universities for additional education and to the International Training Course at Delft, Holland. Actually the major became better known for elements of philosophy that he imparted to students rather than for his ability to instruct in the arts of surveying and mapping, unique as it was. His victorious attitude toward life, his stimulation of a worthy response of the whole man to its tests and opportunities, his refusal to be defeated by setbacks, won enduring appreciation and regard from those who trained under his supervision. To a notable extent he succeeded in transforming hardshell war veterans — men convinced, in some instances, that the world owed them a living — into citizens capable of meeting life on its most challenging terms and of contributing in a worthwhile manner to the general progress of society. His was not a namby-pamby approach to problems but rather a "shirtsleeve philosophy" — a good creed to live by and work by.

Major Church was a master in the art of communicating to trainees in their own idiom. Although not by nature given to the careless use of profanity he did not hesitate to swear vigorously and, in some instances, spectacularly, when an occasion seemed to demand emphatic, colorful language. He would never permit an officer or former officer to "pull rank" on those of lesser army rating when in attendance at the Institute. But he would make a point of inviting, in turn, groups of trainees to his home in order, in some cases, to emphasize the importance of good manners on the part of those accepting the hospitality of a gracious and pleasant hearth. All in all, his was a no-nonsense approach to the tasks of shaping civilized men of worth out of the rawest and most unlikely material. Major Church was deeply convinced that every man, however undisciplined or however unfavorable his early environment, possessed a high potential for solid accomplishment. "Give the youth of Canada", he once wrote, "an integrated education system through primary, secondary, and technical schools to universities and you could make the atomic bomb look like a firecracker."[4]

In reply to a letter from S. G. Gamble, Director of the Surveys and Mapping Branch, Ottawa, at the time of his retirement from the office of principal of the Institute in 1963 Major Church, after acknowledging with gratitude the constant interest shown and help given his educational project by the Ottawa organization, commented that "one is truly thankful that our graduates have proved to be of a calibre satisfactory to the higher echelons of the survey profession in Canada, within the limits prescribed by the very inadequate primary and secondary education possessed by these trainees. That is the raw material of Canadian youth, full of hot initiatives but handicapped by this environment." Up to 1948, out of a total of 20 Institute graduates who took the examinations for a Provincial Land Surveyor commission in Nova Scotia, 15 passed on their first attempt, 4 passed on their second attempt, and only one failed completely. This over-all commendable result was achieved despite the fact that these students were unaccustomed to formal written examination procedures. Graduates of the Institute, and of the School that preceded it, may be found in places of special responsibility in Ottawa, in various provinces of Canada, and in other countries. Burton Robertson became director of surveys for Nova Scotia, succeeding J. E. R. March. Walter E. Servant became a leader in Halifax in the land surveying profession. Both of these graduates have served as members of the Advisory Committee of the Institute.

In 1963 in the Lawrencetown Consolidated School auditorium, on the eve of his retirement after more than 20 years as chief instructor and, later, as principal, Major Church attended the graduation ceremony of that year's class of the Institute. Present also on this significant occasion were Hon. E. D. Haliburton, Minister of Lands and Forests for Nova Scotia and W. Darrell Mills, director of vocational education, Nova Scotia Department of Education. Both men paid glowing tributes to the major's leadership and what he had achieved through the Institute that he had done so much to found and to develop. Mills pointed out that "money and property by themselves can never make a school". With the holding of this ceremony the total number of Institute graduates up to that point in its growth exceeded 200. Students had enrolled for its courses from nearly every province in Canada as well as from Africa and from the West Indies.

In the evening the Old Boys of the Institute feted Major Church in Cornwallis Inn, Kentville. He was made an honorary member of the Canadian Institute of Surveying. Al Grant, the School's first student, first graduate and the major's first assistant in the administration of the Institute, made a presentation to the retiring principal on behalf of all in attendance.[5] The Lawrencetown and District Board of Trade, on behalf of residents of the local community and its tributary area, later, in words finely lettered on parchment expressed deep appreciation to Major Church for his "untiring zeal . . . foresight, perspicacity and energy in efforts to enlarge the size and scope of the training courses given at the Institute . . . for years of faithful service to youth . . . we are proud of your good works and honoured by your presence among us." One of the satisfying aspects of the operations of the Institute in Lawrencetown has been the continuing good relations between the staff and students on one hand and citizens of the community at large on the other. Moreover the success of the Institute in Nova Scotia has resulted in a general improvement in the status of surveying and mapping in the entire region comprising the maritime provinces.

The Institute building, with two classrooms on its lower floor for lectures in land surveying and with separate classrooms on its upper floor for instruction, respectively, in map draughting and in photogrammetry, approaches in some aspects the early dreams of its principal founder. There are plaques in the building to commemorate the special gifts of Dr. Hall and of the Canadian Legion. To testify to the genius of Major Church there is not only the structure itself but the program of the Institute which promises to continue producing well-trained technicians and highly desirable recruits for the profession of land surveying.

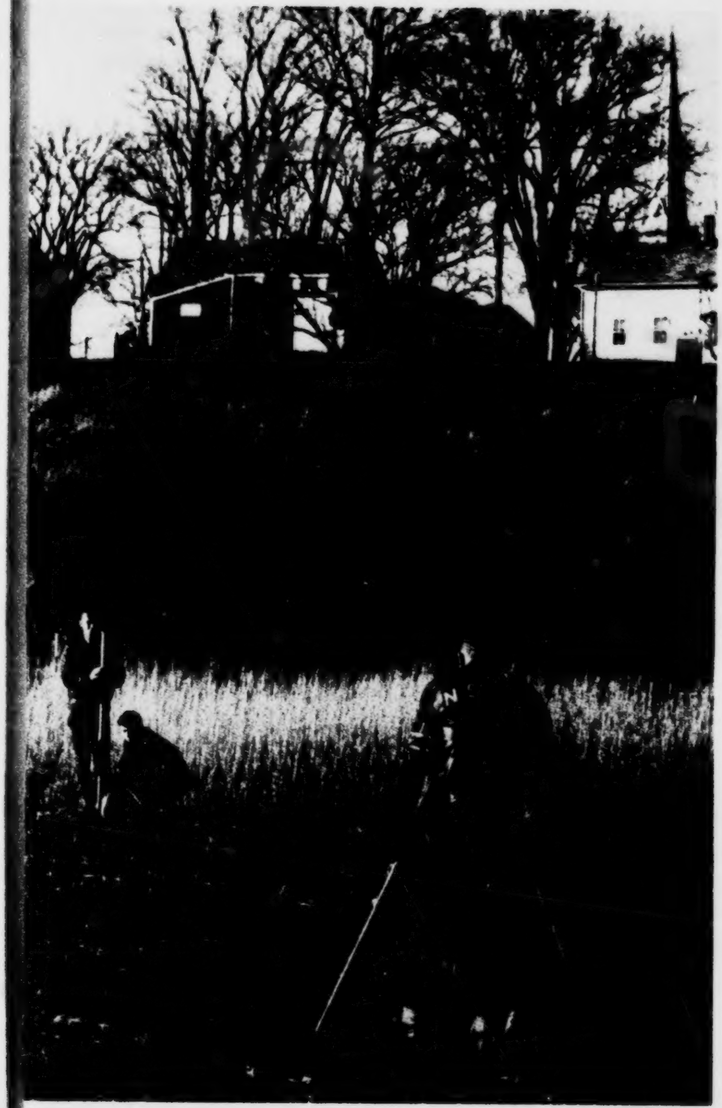

FIGURE 141
Student surveyors on field practice near Lawrencetown.

In Canada as a whole a wide spectrum exists in the means of attaining education in surveying as well as in the level of professional recognition given in each of the eleven principal jurisdictions covering land surveyors and surveying in this country. Three Canadian universities now offer specialized education in surveying. There are now two fully developed degree courses along these lines at Laval University, Quebec, and the

University of New Brunswick. The University of Toronto offers a survey option within its Department of Civil Engineering. At the University of British Columbia optional courses in control surveys and in photogrammetry are available to civil engineering classes.[6]

In addition well-established technician courses in Nova Scotia and Alberta continue to attract young Canadians to the profession. The series of rapid technological developments experienced in Canada during the two decades following the end of the Second World War constituted a most dramatic evolution in survey education. In Calgary the Southern Alberta Institute of Technology is a senior Canadian technical training institution. Programs in survey education, commencing in 1920, developed into a course of two years duration in the early 1930s. By 1945 steps were to be taken to devise a course to meet the requirements of modern surveying as defined by the Alberta Land Surveyors' Association. There was to be an even more explosive growth in survey courses available to technicians and technologists at institutions across the country after passage of the federal Technical and Vocational Training Assistance Act in 1961. As of 1968, the year after the death of Major Church, there were in Canada ten established or proposed 2-year survey technician and technology courses in addition to and following the early example of Nova Scotia and Alberta.[7]

17

REPRESENTATIVE RAILWAY SURVEYS IN CANADA: 1917-1947

The completion in 1885 of Canada's first transcontinental railway, the main line of the Canadian Pacific, ended what may be described as the experimental period in the history of Canadian railway construction. What had appeared to many observers as quite impossible of achievement had, in fact, been accomplished. Critics who had warned that such a railway would soon amount to "two streaks of rust across the prairies" had been confounded and silenced.

The years between 1885 and 1914 may be regarded as years of enthusiastic development, if not over-development, of Canada's rail services. The amalgamation in 1899 of two rail projects in Manitoba heralded the formation of Canada's second transcontinental railway, the Canadian Northern. The Grand Trunk Pacific Railway Company had come into existence to help develop territory farther north than areas served by the other two major companies and to open a port on the Pacific Ocean in a more northerly situation than those located on the Strait of Georgia.

With the growth of population in the western interior and with the resulting upsurge in grain-growing in that region, the development of overseas markets, especially for Canadian hard wheat, became highly important. Europe offered the most attractive market abroad at the time. The transcontinental railways and numerous feeder or branch lines having been built, the attention of western Canadians, particularly in Manitoba and Saskatchewan, turned to the problem of how best to construct the shortest rail line from the high plains to Atlantic tidewater.

Maps clearly demonstrated that such a line would be one connecting the settled parts of Manitoba and Saskatchewan with Hudson Bay. The federal government, in fact, had made an offer to grant land to any responsible party prepared to build such a railway. It was an offer that remained in effect from 1866 to 1908. The Canadian Northern

Railway Company responded to this inducement when it built a line from Hudson Bay Junction to The Pas. The former point, located in Saskatchewan, was east of Melfort and not far from Manitoba's western boundary. This relatively short line was at least a beginning. The land offer was withdrawn in 1908, however, and the federal Department of Railways and Canals appointed one of its engineers to organize appropriate surveys and to report on the cost of building a railway to extend from The Pas to Hudson Bay. In anticipation of a settlement emerging at Churchill the Department of the Interior made surveys of that port in 1908, including the laying out of a townsite there.[1]

In the autumn of 1909 one William Beech was granted a homestead within Churchill townsite, consisting of a rectangle of land enclosing 40 proposed city blocks, including street allowances. In addition to this area of 176 acres C. E. Beech purchased two parcels of land in the vicinity so that the three adjoining areas totalled 300 acres in all, distributed over 1,400 town lots.

In his preliminary report of February, 1909, the federal engineer designated to investigate construction costs mentioned that two ports on Hudson Bay offered rail terminal advantages. These were Churchill and Port Nelson, the latter located near the mouth of the Nelson River. Estimates of the cost of installing suitable port facilities favored Port Nelson by about $4,000,000. By August of that year surveys of both harbors had been completed and from these surveys it appeared that Port Nelson, 510 miles across northeastern Manitoba from The Pas, would be more suitable as a rail terminus on tidewater. In 1909 railway location surveys commenced and in 1910 a contract was awarded for the building of a bridge over the Saskatchewan River at The Pas. In the following year a contract for grading the first 185 miles of the line was let and, late in 1911, the "firm" decision was made to carry the proposed railway to Port Nelson. Contracts for grading the remaining mileage to that port were awarded accordingly.

Early in May, 1913, a location survey party for this project embarked, with gear and supplies, on S.S. *Wolverine* at Selkirk and travelled along the Red River and across Lake Winnipeg to Norway House. Survey work that season began from the point where the railway line was projected to cross the Nelson River at Manitou Rapids. During that field season one man, although a strong swimmer, drowned when a canoe capsized in turbulent water.

Port Nelson entered into a period of lively construction. A man-made island, at which deep-sea vessels could tie up, was built in the estuary of the Nelson River, a 17-span steel bridge, almost two-thirds of a mile long, connected the island with the mainland. A 40-room hotel, a number of houses and certain other installations were erected.[2] Why, one may well ask, with the later adoption of Churchill as the terminus on Hudson Bay, was the initial selection of Port Nelson ever made? Lack of adequate knowledge at the time of decision would appear to be the answer to that question. For example, a 75-mile section of track at the Churchill end of the line would need to be located, if built, over frozen muskeg. It was anticipated that under the hot summer sun the roadbed would soften and be absorbed by the muck. Again, there was every indication of the presence of solid rock in large quantities in the port bottom at Churchill, a fact that would make the cost of any required dredging excessive, if not quite prohibitive. The area for mooring vessels at Churchill also appeared less extensive than at Port Nelson. Finally, the mean annual temperature at Port Nelson was higher than at Churchill. But subsequent investigations disposed of most of these arguments. It was found that substantial quantities of 'gravel fill' over muskeg acted as a heat insulator and prevented weakening of the roadbed's foundation. Test borings at Churchill revealed an area in the harbor free from rock. With the establishment of the channel and deep-water wharf at Churchill, any mooring problem in that harbor would be solved.

In anticipation, however, of the choice of Port Nelson as the Bay terminus a federal departmental engineer was sent to the mouth of the Nelson River to investigate the situation and to recommend a site for the proposed town. In 1911 the Naval Service of Canada had commenced a hydrographic survey of the Nelson River estuary. With the 1912 extensions of Manitoba's boundaries both Churchill and Port Nelson were included within that province.

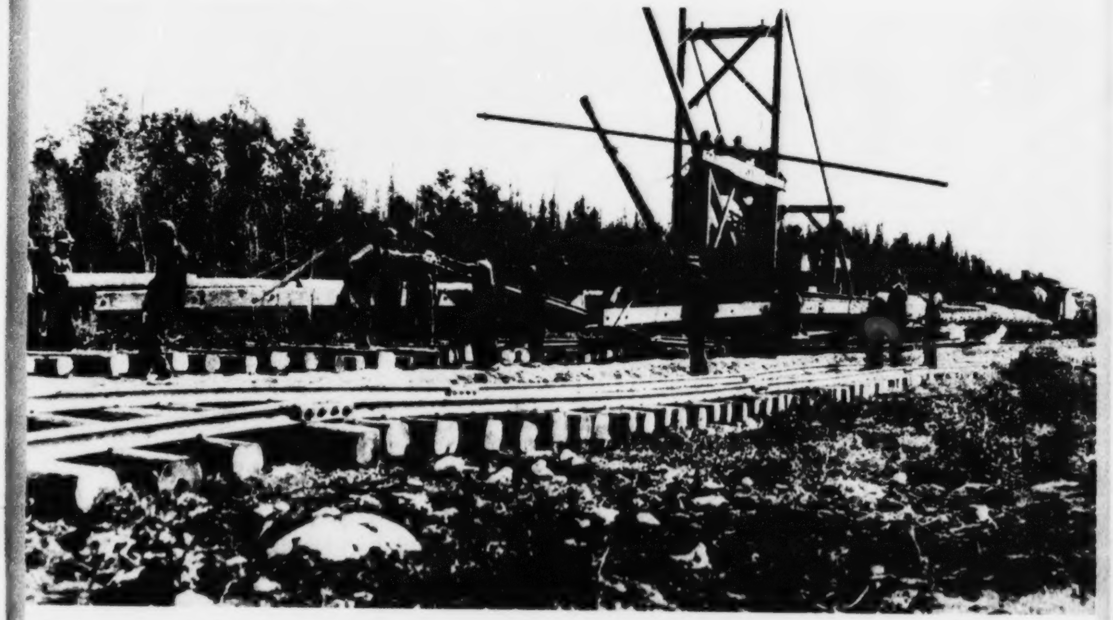

FIGURE 142. Construction work on Hudson Bay Railway about 1915.

But the advent of war in Europe following upon a drastic decline in the prosperity of the Canadian West, brought about in this country the replacement of policies of expansion by policies of contraction. In the realm of Canadian railways the age of optimism gave way to the age of mergers. First, the Canadian Northern lines were absorbed by the Canadian Government Railways, a name which, by 1918, was applied to all rail lines owned and controlled by the federal government.[3] By 1923 the Grand Trunk Pacific had been taken over also by the government of Canada and early in that year all Canadian Government railways were placed under the Canadian National Railways Company (incorporated in 1919) for management and operation.* Other mergers of rail services took place over the next following ten years, including the joint purchase by the Canadian National and Canadian Pacific railways of several lines in Alberta in 1929. These were the Edmonton, Dunvegan and British Columbia Railway, the Central Canada Railway, the Pembina Valley Railway, and the Alberta Great Waterways companies. These four lines were consolidated into one corporation, the Northern Alberta Railways Company, which operated them on behalf of their joint owners.

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*O. in C. P.C. 115, Ottawa, Jan. 20, 1923.

It was against the background of these and similar developments that railway construction was resumed in Canada in the aftermath of the First World War. In the period between the two world wars a number of branch lines were built in the western interior, the railway to Hudson Bay was completed, the Temiskaming and Northern Ontario Railway (later renamed the Ontario Northland Railway) was extended from Cochrane to Moosonee, and major location surveys made by the Canadian Pacific Railway in mountain passes leading from the Peace River country into central British Columbia.

During the autumn of 1913 location survey work had been completed on the Hudson Bay Railway from The Pas northeastward as far as Kettle Rapids and Mile 332. For purposes of transport after freeze-up dogs were used to haul sleds until open water in the springtime made possible a return to canoes. By the following August the survey line had reached Hudson Bay. The surveyors and their helpers lived in happy comradeship and in good health despite reliance on a diet that lacked fresh vegetables, fruit or eggs and with little fresh meat but with no scarcity of fresh fish. Work advanced at the rate of 10 hours each day during all seasons. Angles were measured, levels taken and distances chained amid clouds of mosquitoes and voracious black flies during the warm months and sometimes in temperatures of 60 degrees below zero during winter months. After evening meals several hours were usually occupied in making calculations and plotting notes, often by candlelight. At the end of 1918 the right-of-way had been surveyed, cleared and graded all the way to Port Nelson, including construction of steel bridges at two crossings of the Nelson River, the second of which was built over Kettle Rapids. Grading operations had been carried out almost entirely by hand. Drainage of extensive belts of muskeg constituted a major accomplishment in making progress. Ditches were cut through layers of permafrost by the use of axes and hand shovels. A limited operational service out of The Pas, over the newly-laid rails, was in effect as far as Mile 214 in that year although by 1918 rails had been laid to Mile 332, just north of the bridge crossing the Nelson River at Kettle Rapids.

Very little money was spent on line maintenance over the operating part of the Hudson Bay Railway in these early years and it was not until 1926 that the task of completing construction to the Bay was actively resumed by the federal Department of Railways and Canals. During the 8-year interlude railway ties had rotted and embankments, in some sections, had fallen in. Frost damage had been extensive and restoration of the entire trackage had to be undertaken by the Canadian National Railways, the corporation authorized to complete the line.

Meantime a new situation had developed. A special committee of the Senate recommended, in 1920, that before additional important expenditures were made on the building of a railway to Port Nelson, an exhaustive examination ought to be made of the relative merits of Port Nelson and Churchill as rail terminals. The federal government called upon (Sir) Frederick Palmer of London, England, an eminent authority on port construction, to conduct a probe of the situation and in August, 1927, along with a bevy of Ottawa officials, Palmer visited both places. As a result of this investigation the abandonment of Port Nelson was recommended and the selection of Churchill approved.

The decisive considerations were that it was possible to make a better harbor at Churchill, the cost of construction would be less than similar work performed at Port Nelson, and could be completed in three years less time. There were unofficial indications also that silt deposited by the Nelson River near its mouth created special problems in the docking of large vessels at the Port Nelson site.

Once the decision was made to develop Churchill, the federal government instituted expropriation proceedings against William and C. E. Beech in order to prevent land speculation at or near the new terminus and to avoid a premature influx of settlers in its vicinity. In relocating the rail line between Mile 332 and Churchill the most economical route was found to follow the Port Nelson line as far as Mile 356. From Amery, a railway station a short distance west of the Second Meridian East, the line turned and headed due north toward Churchill, running somewhat to the west of that meridian, located at 94° West longitude, and generally parallel to it. By April 1, 1929, steel had been laid between Amery and Churchill. Much of the final trackage along this route had to be laid, however, on permanently frozen ground and swampland, without use of ballast. All ballasting was completed by September 14, 1929, in time to permit transportation by rail of timber and other products to the new port before the onset of winter.

It has been found that if due care is taken not to destroy natural surface insulation, roadbed on the more northerly mileage does not require unusual maintenance or costs even after more than 35 years of operation. Favorable grades on the Hudson Bay Railway enable trains of 174 freight cars, 1.6 miles in length and capable of transporting 300,000 bushels on one shipment, to be hauled with a distinct economy of power to tidewater at Churchill.

From Munk's time, early in the 17th century, those who established themselves at the mouth of the Churchill River, including the men responsible for the building and operation of the earliest Hudson's Bay Company posts and Fort Prince of Wales, had chosen the west side of the harbor to locate. But when the time came to select a site for the rail terminus, including railway yards, deep-water wharf and townsite, it was obvious that the east side was more suitable for such developments. No sooner had a temporary wharf been built in the 1928 season than ships began to arrive with timber, coal and other cargoes. As a natural haven from storms Churchill harbor did not need improvements. No matter from what corner strong winds or even gales might blow, the rocky shores beat off the roughest seas. This sheltering effect obtains even with a wind blowing straight through the harbor entrance because the passage is narrow and the harbor channel twists sharply once the entrance is negotiated. Anchorage is available up to 35 feet in depth at low tide. The tidal range for spring tides at this point on Hudson Bay is from 14 to 16 feet. Although shores are rocky it was found by borings that the channel and wharf could be located so that no rock would be encountered at less than 30 feet below low-water level. The expense of dredging in rock was avoided accordingly.

From 1928 to 1935 inclusive, intensive surveys were made by various vessels in Churchill harbor and vicinity to ascertain the arrival dates of the opening and closing of navigation. It was found that over that 8-year span, ice broke up in Churchill harbor between June 7 and June 21. It was also discovered that ice formation ended navigation at Churchill on dates ranging between October 14 and November 3.

The opening of Churchill as a commercial port took place in September, 1931. The ice hazard in the Strait during parts of the open navigation period was sufficiently serious to require an efficient patrolling operation by a powerful icebreaker. To provide this service a new oil-burning icebreaker was launched by the Department of the Marine in 1930 and the vessel was named *N. B. McLean*.

A substantial part of the federally-owned area at Churchill not required for rail terminus development was transferred in 1930 to the Province of Manitoba for the establishment of a townsite.* In the following year a sloping tract of land near the terminus was surveyed in lots and streets.

Aerial Photography and the Railways: 1925-1945

As a result of progress made in the science of aerial photography during the First World War, the airborne survey camera came into considerable use in Canada in the 1920s. For the most part air photography in those days was employed to supplement ground surveys in the mapping of forested and mineralized areas as well as in the revision of old maps and in the preparation of base maps. It would appear, however, that the decade immediately following the conclusion of the war was a period too early in the development of the airborne camera technique for its effective application to railway location work. Nevertheless, during the construction stage of the Hudson Bay Railway, numerous air photographs were taken along its right-of-way as early as 1925.

In the previous year a letter from Henry K. Wicksteed, F.R.G.S., addressed to the Royal Canadian Air Force, Ottawa, was printed as Appendix C of the Air Board Report. In this letter Wicksteed, who had been engaged for some months in 1924 on a preliminary survey and reconnaissance for location of a proposed railway in northwestern Quebec, made extensive comments on the use of aerial photography for that purpose. To study, on foot, the 8,000 square miles in which his employer railway company was interested would be "almost hopeless in our northern forest where the field of view is always restricted . . . ," Wicksteed pointed out. "But", he added, "the aeroplane is swift . . . two or three hundred square miles may be looked over at once, superficially, it is true, but quite often the superficial view is all that is needed to eliminate a portion of the territory from consideration and railway reconnaissance is largely a process of elimination of the impracticable and undesirable. The strong point of the aero-survey is in the mapping . . . far superior to the rough sketches now available . . . We always know that streams or lakes occupy the lowest points in the immediate neighborhood and, as a railway affects low ground, this alone is knowledge of great value to the engineer.

"The functions of the aeroplane are two-fold: (a) to give a wide and comprehensive idea, first by direct vision and, secondly, through the medium of the camera, of a great expanse of country — and (b) to supplement the exact instrumental survey by a vast amount of detailed information, performing these functions with a minimum loss of time and with absolute fidelity. As an aid to the engineer . . . it is difficult to overestimate the value of these photographic documents and plans."

Although some early experiments were carried out in this country using Curtiss HS 2L flying boats, the first aircraft regularly employed for photogrammetric purposes in Canada was the Vickers Viking. This was a relatively low-speed type of flying boat operating under a ceiling of about 5,000 feet but able to land with ease on fairly small bodies of water. The maximum length of a photographic flight in such a plane was 225 miles and, for reasons of safety, orders were issued that the planes were not to be flown at any distance from lakes or rivers (suitable as landing places) exceeding one mile for each 1,000 feet of altitude. In these flying boats, equipped with "pusher" type propulsion, the photographer would stand in the forward cockpit, exposed to wind and weather, taking oblique photographs directly forward and, in turn, at about 45 degrees to each side.

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*O. in C. P.C. 537, Ottawa, March 12, 1930.

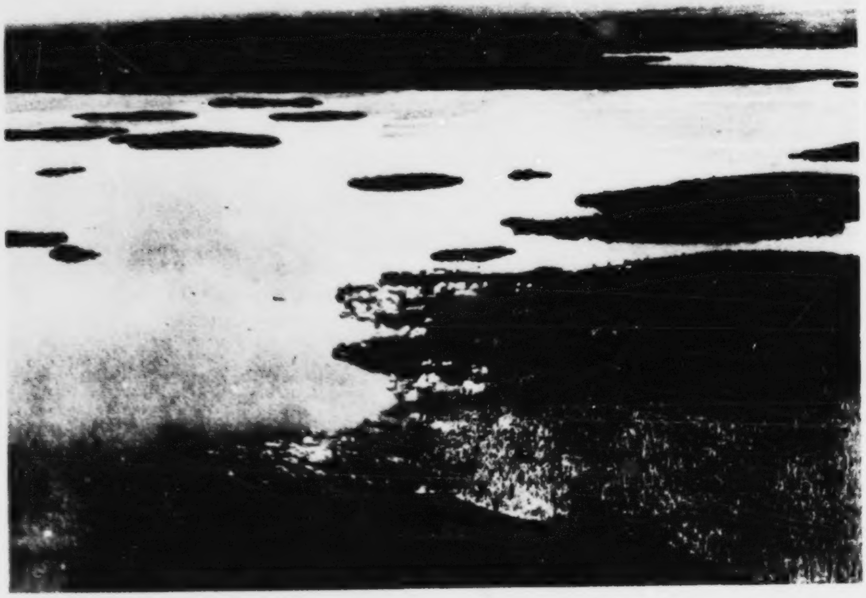


FIGURE 143. Oblique photograph of Pelican Narrows, Saskatchewan, taken at 3,000 feet, 1922. Regarded as the first Canadian air mapping photograph.

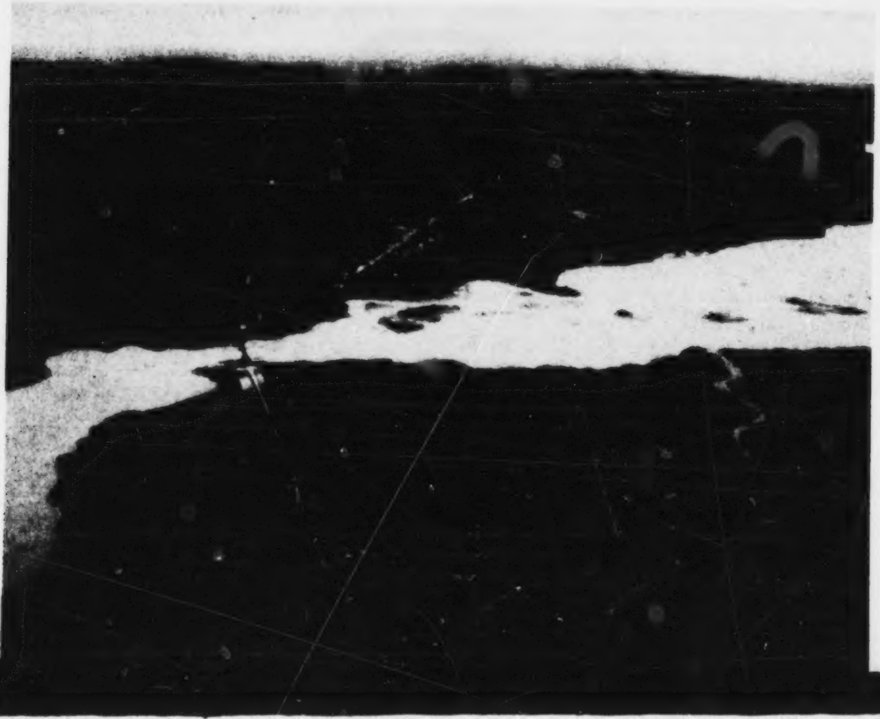
Initially the Viking was quite satisfactory for photographic purposes but, in time, its mahogany hull began to absorb water and to become heavier, leading to less efficient performance. Nevertheless these were the pioneer planes by which it was possible to advance Canadian air photographic techniques. The Viking was superseded by the Vedette, a smaller and more efficient craft. The Vedette, as far as can be ascertained, was the first flying boat in Canada on which a vertical camera was mounted inboard. This type of plane, which came into service in the mid-1920s, remained in use for some purposes in this country until the outbreak of the Second World War. Vikings and Vedettes were used to obtain oblique photographs of large areas of Canada for mapping by the grid method.

The pilots of these early aircraft in Canada did not have the benefits of modern aids to air navigation even when their operations extended into the Arctic. Some parts of the coastline of the Arctic Ocean were photographed from Vedettes by crews who, without assistance from meteorological forecasts, radio aids to navigation and other facilities, had to rely solely on their own competence sparked by the spirit of adventure and accomplishment. When flying over large expanses of this country familiarity with the appearance of pine trees of peculiar shapes along the route was a requisite of good airmanship. Any railway line in these remote areas was known to these flyers as an "iron compass".

In 1933 open cockpit flying boats were replaced by high-wing monoplane cabin aircraft which, for most photographic operations, were mounted on floats. These planes had increased range and performance. The earliest of these machines was the Fairchild FC2W. Photographic methods changed with the advent of cabin aircraft. Initially the camera was mounted under the fusilage, pointed aft for oblique photography but this arrangement was soon superseded by a combination of three fixed cameras mounted on a wooden beam inside the cabin. About the end of the Second World War trimetrogon photographs were being taken from Mitchell aircraft. When additional range proved desirable in remote regions the Lancaster bomber, denuded of armament, was adopted. This plane made it possible for the Royal Canadian Air Force, for the first time, to conduct planned and systematic tri-camera or vertical photography over any part of Canada. Other types of aircraft prominent in wartime, such as the Dakota, were also used for vertical photography within limited ranges.[4]

Canadian civil aviation authorities in their 1925 report indicated that the field program that year of the Topographical Survey, Department of the Interior, would include photography covering more than 30,000 square miles in eastern Manitoba and western Ontario, approximately 20,000 square miles in northern Manitoba and, because of public interest in the project, *over the Hudson Bay Railway as far as Port Nelson*[5] [author's italics]. However, the Topographical Survey annual report for the season makes no mention of any photographic flights along that railway. Because of unfavorable weather the two Vickers Viking amphibian flying boats employed to carry out the year's program failed to complete all of the operations planned for that season. Excerpts from the pilot's report on his flights over the railway line are revealing. His working altitude for this project was 5,000 feet.

FIGURE 144. Railway crossing at Kettle Rapids on Nelson River, 1925. Airphoto at 3,000 feet.



"The first flight", he reported, "was carried out on September 3 [1925]. Two previous attempts had been made but were discontinued owing to clouds and haze. Photographs were taken that day on the railway from The Pas to Bowden [Mile 137] where the aircraft refuelled . . . On the 12th the remainder of the railway was photographed though in the vicinity of Kettle Rapids the sky became overcast and two light snow flurries were experienced . . . There is at present no protection for any aircraft landing at Port Nelson and the alternative is to moor in what amounts to open sea conditions or to run up on the shore at hightide and rest in the mud."[6]

FIGURE 145. Oblique photograph, 1929, of port area, Churchill, Manitoba, at 3,000 feet.

More than 1,000 aerial photographs taken during 1929 by the Royal Canadian Air Force along the Hudson Bay Railway to its new terminus, Churchill, are in the possession of the National Air Photo Library, Ottawa. But the report on that year's activities issued by civil aviation officials, as well as the regular annual report of the Topographical Survey covering that season, fail to mention any such photographic project. In any event these flights came too late in the course of this railway venture to have had any connection with survey location work. The planes and pilots employed on these pioneering photographic flights in the 1920s were provided by the Royal Canadian Air Force, a name that was in actual use some months prior to its official adoption on April 1, 1924.

In 1931, however, the Canadian Pacific Railway undertook railway location surveys through the Peace Pass and Monkman Pass routes at a time when the attention of the Canadian public and parliament was fastened upon the need for building a rail line linking the Peace River country with a port on the Pacific Ocean. In commenting on the surveys on the Peace Pass route, covering a distance of 960 miles, Thomas Creighton Macnabb, Engineer of Construction, Canadian Pacific Railway Western Lines, declared that the use of aerial photographs on this project "very greatly speeded up the [location] work and gave a certainty to the conclusions which could not have been reached otherwise. The work was completed in one season; in earlier days it would have taken three years. It was more efficiently done and a decidedly more satisfactory record was obtained."

On this and several similar survey projects conducted by the Canadian Pacific Railway under Macnabb's direction that season, about 30,000 aerial photographs were taken. This accomplishment inspired Macnabb to state further that "the airplane is an unrivalled agent in giving maximum information with minimum expenditure of time and effort. There is the whole science of mapping from the air, using vertical or oblique photographs and interpreting them by means of stereoscopes. For railway locating nothing has ever been so comprehensive as this. But it cannot be used wisely unless the engineer has had a great deal of experience on the ground and is familiar . . . with the type of country to be studied from the air."[7]

The Second World War brought about even more startling advances in this realm of photogrammetry. During 1942, for example, United States and Canadian army engineers, making use of aircraft for transportation, reconnaissance and photography, succeeded in staking the preliminary location, within a period of five months, of a military railway projected to run from Prince George in British Columbia along the Rocky Mountain Trench to Alaska, a distance of some 1,500 miles.[8]

Macnabb's views on the pronounced advantages of the airborne camera in railway location surveys were echoed thirty years later by J. L. Charles, regional chief engineer, Canadian National Railways, Winnipeg, and later consulting engineer to that system. A distinguished veteran of two world wars who rose to the rank of major, Charles pointed out that as a result of scientific advances made during the Second World War it was possible, even by the mid-1940s, for experienced railway surveyors, working on the Alaska Railway project over most difficult Canadian terrain, to determine the most feasible route with great speed and efficiency. In spite of swift rivers flowing through deep canyons, areas of treacherous muskeg, high summits and unstable side-hills of slippery clay, reconnaissance engineers were able to examine, during a relatively short period, several possible routes from the air and to select the most practical one.

Railway Location Survey Procedures: After 1945

The foundation of any successful railway consists, in the planning stages, of adherence to such basic factors as a low rate of ruling gradient, minimum rise and fall, curvature and distance established in relation to sources, classes and volume of traffic on the proposed line and to a reasonable investment in it. Reconnaissance of the territory to be crossed by the railway is therefore the first and by far the most important step in the advancement of the project.

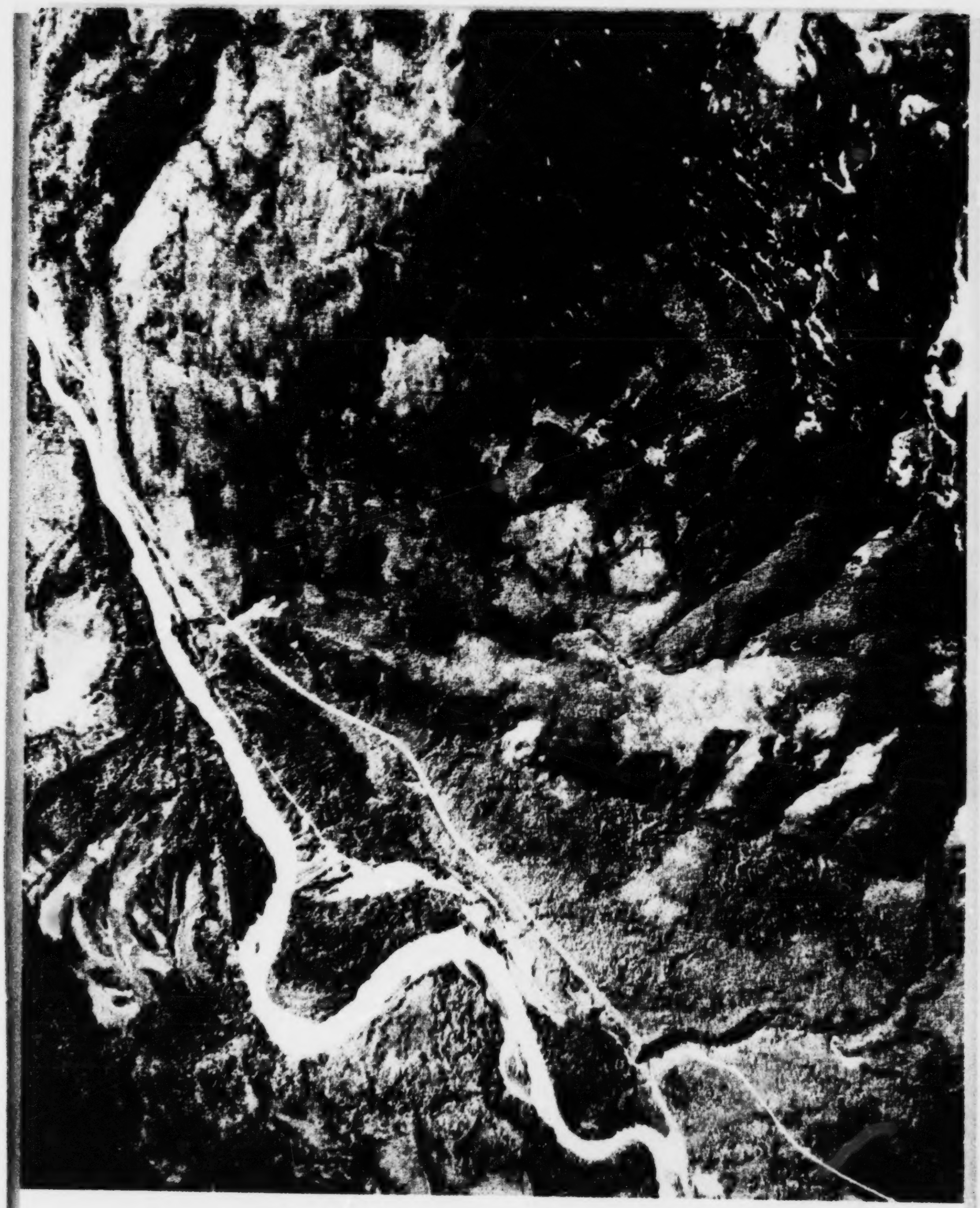


FIGURE 146. Canadian National Railways' Prince Rupert line from the air, 1949, showing route through Bulkley Canyon near Hazelton, B.C.

The time required by the various surveys involved has always been an important consideration in the building of a railway and never more so than in the construction of Canadian lines after the end of the Second World War in order to further develop the country's natural resources. By that stage in our history types of aircraft, advanced equipment and highly precise instruments, including much improved models of airborne cameras, had become available and, in combination, served to reduce very considerably the physical labor and time required to complete location surveys.

Light aircraft and helicopters, camera-equipped and carrying two-way radio apparatus, could be employed for reconnaissance purposes. Air photography produced a series of prints for study in stereo pairs. Subsequent photogrammetric procedures enabled a map to be plotted showing surface features and contours of a strip of territory along the general route of the proposed rail line. A series of such aerial photographs could then be subjected to photo analysis and interpretation in order to disclose the extent of timber growth, the nature of the drainage, depth of overburden, soil types and their suitability for grading operations, muskeg or swamp depths as well as locations of sand and gravel pits required for ballasting operations. Following the accumulation of this information ground controls could be set and distances estimated between defined photo points and respective elevations.

The tasks of measurement had been expedited and the accuracy of results increased by the use of electronic instruments such as the tellurometer. Stereo plotting machines, operated by skilled technicians, produced strip maps of the country along the right-of-way. Such strip maps might cover as much as 2 miles in width and many miles in length. The centre line of the railway could then be projected by an experienced engineer as a "paper location" and the relative cross-section or profile accurately plotted and the grade line set. With the advent of electronic computers, survey engineers were relieved of mass repetitive calculations. Also, by feeding into a computer such data as track, train and motive power characteristics it became possible to simulate expected train performance and to evaluate the merits of alternative routes in the light of total running times and maximum speeds, costs of line maintenance as well as of bridges and other required structures. But more significant than any mechanical devices in the prosecution of railway location surveys is the possession by the reconnaissance engineer of a "good eye for country" and of actual experience in his special field.[9] Finally, comes the staking of the preliminary line, establishment of bench marks, and of profiles "on the ground". The design for the railway can then be completed.

Aerial Photography and the Railways: After 1945

(*a*) *Quebec North Shore and Labrador Railway*

One of the early Canadian examples of full productive use of air photography in railway location surveys was provided in the case of the Quebec North Shore and Labrador Railway project. This line, beginning at Sept Iles on the north shore of the St. Lawrence River runs almost due north through some of the most rugged terrain in eastern Canada to reach Schefferville, some 356 rail miles away. The completion of this railway, a subsidiary of Iron Ore Company of Canada, made possible the development of rich iron-ore deposits in the Knob Lake region. Transportation of men, supplies and equipment by air was also a vital factor in this impressive undertaking. Within three

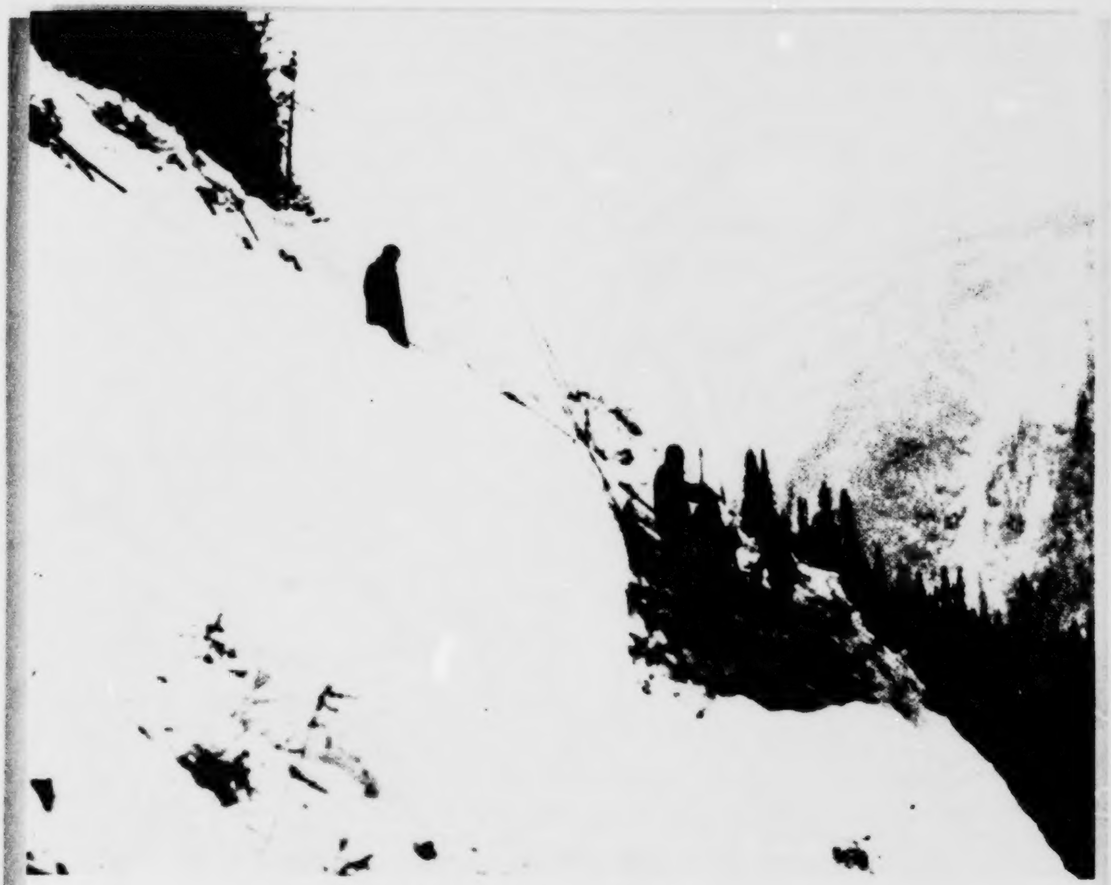


FIGURE 147. Knob Lake railway under construction.

years a total of 15 million tons of freight was airlifted in support of the enterprise. Eleven temporary airports were built along the route to facilitate the flow of this type of traffic.

In the summer of 1945 D. A. Livingston, a Vancouver engineer, began air reconnaissance surveys in search of the most feasible route for the railway to follow. Line location surveys continued under his direction from 1947 to 1950 inclusive. At the outset a careful study was made of map sheets published by the Hydrographic and Map Service, Ottawa, on a scale of 8 miles to the inch, each sheet covering 4 degrees of longitude and 2 degrees of latitude. These maps were useful especially in showing the drainage systems of the areas under examination. Employing canoes as well as a Fairchild plane, with Hank Gates as pilot, Livingston completed 20 days of reconnaissance on July 4. Hitch-hiking on one occasion on a Stranraer flying boat that was transporting supplies to a geological surveyor's camp at Hollinger Lake, Livingston found the Moisie River valley in one stretch "a tortuous semi-canyon with sharp bends and requiring much tunnelling, with solid rock predominating."[10] On crossing the height of land the engineer observed that the country was swampy, with low ridges and islands of sand.

Again using canoes and a plane, with Johnny Dart as its pilot, Livingston completed his reconnaissance by exploring, in particular, the height of land area during a further period of 35 days. In timbered parts of the watershed country he found spruce, tamarac, birch and poplar, with spruce predominant. Livingston's initial surveys produced information on elevations of terminal and other strategic points; of grades and summits, passes and lakes. Elevations of streams were obtained at frequent intervals. Stream profiles were plotted.

After reconnaissance of the general area to be crossed by the rail line, the standard railway survey procedure was followed, namely, a preliminary survey was carried out to select the best of the several possible routes determined by the reconnaissance. What appeared to be the most feasible routes were first marked on maps, followed by an examination of each route on the ground. A flight of aerial photographs was taken along what was regarded as the most suitable location of all. Each photograph covered an area approximately 6 miles east-west and 3 miles north-south. Extensive use was made of these photographs in locating the selected route on the ground and in planning subsequent survey operations. Several of the routes under consideration were eliminated at this stage because of their undue length of line or unfavorable grades.

The second, or preliminary survey, stage of the project commenced in the summer of 1947. Two field parties were active on this phase of activities in summer and winter until 1950. Summer crews moved by canoe or boat on the larger lakes and rivers. Winter crews used dog teams. Each party was composed of 18 to 24 men and consisted of a locating engineer, transitman, leveller, draughtsman, two topographers, a head chainman and rear chainman, rodmen, stakemen, two axemen, three canoemen or (in winter) dog drivers, a cook and his helper. A continuous contour plan and profile, revealing all topographical features related to the location line, was maintained on a daily basis.

In regions where lakes predominated, prevailing strong north-west winds often seriously hindered canoe travel. This problem was largely overcome by the building of large, flat-bottom plywood boats, driven by 10-horsepower outboard motors. Such craft were built at Sept Iles in sections and then flown inland. Each field party was equipped with two boats of this type. Survey parties considered that good progress had been made if they covered from one-half a mile to one mile each day. On the Labrador plateau, however, better headway was made and parties averaged 2 miles per day. On location work on this project a total of 1,057 miles of survey line was run.[11]

The maximum elevation on the Quebec North Shore and Labrador Railway is 2,066 feet. The ruling grades, compensated for curvature, run 0.4 per cent against loaded southbound cars and 1.32 per cent against northbound empties. The route follows the natural drainage patterns of the country traversed, crossing the narrow coastal plain just to the north of Sept Iles, rising to the coastal highlands along the valleys of the Moisie, Nipisso, and Wacouno rivers to Mile 130. Then the route follows the Magpie River to the height of land near Mile 150, then enters the Labrador plateau, skirting lakes to Mile 330. Across the remaining distance the line follows the Labrador Trough to Schefferville (Knob Lake) at Mile 356.

(*b*) *Ontario Northland Railway*

In 1921 construction began on the 187-mile extension of the then Temiskaming and Northern Ontario Railway from Cochrane to Moosonee, its James Bay terminus located at 51°20′ north latitude. The undertaking involved a total descent to sea level of 881 feet. Although the railway location survey party lived in light silk tents throughout the winter and, at times, slept in the open in weather 55 degrees below zero, the experience was not all hardship. The quality of rations was good, each man knew his assignment and all worked together as a happy team. Activities were planned systematically well in advance, including provision of a special Christmas dinner along with a gallon of rum. This feast was celebrated near the crossing of the Owl River and, appropriately enough, involved a considerable amount of hooting. During the first winter bridges were built close on the heels of those performing the reconnaissance and location surveys. Piles for these structures were driven into position in permanently frozen ground by the use of steam jets.[12]

Urgency was the watchword of this initial drive northward. In order to bring timely aid to the establishment of a hydro-electric plant in the canyon of the Abitibi River it was necessary to expedite building of 44 miles of line out of Cochrane. The season of 1923 marked the start of construction, consisting of several stages, of railway mileage to Rouyn, Quebec, a point reached four years later. In 1928 location surveys led the way once again to the north, reaching Moosonee in time to permit trackage to reach that terminal in 1932.

(*c*) *Sherridon-Lynn Lake Extension*

One day in 1941 a prospector, travelling along the shore of Lynn Lake, Manitoba, about 500 miles northwest of Winnipeg, discovered an outcrop of mineralized rock which proved, on assay, to be 6 per cent nickel, a very rich strike of this metal. At Sherridon, Manitoba, upwards of 150 miles to the south, the Sherridon-Gordon Mine was becoming depleted. In order, however, to ship nickel and copper concentrates from the newly-found deposit to a refinery near Edmonton, Alberta, construction of a 144-mile rail extension from Sherridon was considered by the company to be essential to the success of the enterprise. Negotiations between the company and the Canadian National Railways led to the decision of the latter to build a rail line to Lynn Lake. In 1951 the project was authorized by Parliament.[13] A time limit of 32 months was set for completion of the line through country that was virtually uninhabited and unsurveyed.

Topographical features in that part of Canada show a general east-west trend and consist mainly of rocky ridges, numerous lakes and rivers as well as many areas of muskeg. A major waterway, the Churchill River, had to be crossed. Trees in this region were rather small and widely scattered.

In February, 1951, initial surveys of the line commenced and by the end of that year location work had been completed as far north as the point at which the Churchill River was to be bridged. Aircraft was used for reconnaissance purposes as well as for facilitating the movement of men, supplies, and camp equipment.[14] Because of the numerous waterways three major steel spans, one small steel bridge, and some 65 timber bridges as well as more than 500 culverts were required. Following air reconnaissance, examination of principal natural features was made on the ground so that a study might be made of comparative factors such as distances, topographical formations, ruling gradients, curvatures, construction and maintenance of way costs.

After consultation with officials of the Department of Mines and Technical Surveys, Ottawa, it was decided to employ several ground survey parties to be aided by aerial photography and air transport. After examining the air photographs in stereoscopic pairs, preliminary survey lines were run and maps plotted on a scale of 200 feet to the inch and with contours at 5-foot intervals. These maps covered 1,000 feet on each side

of the preliminary line. Location was projected on map sheets and then established on the ground. After additional study, revisions of the line were made wherever improvements in alignment or in the reduction of construction costs, or both, would result.

The length of this railway, upon completion, did not greatly exceed the airline distance of 120 miles between Sherridon and Lynn Lake. By the exercise of careful line-location procedures the percentage of track on muskeg was kept relatively low. Not more than 10 per cent of total quantities of excavated material along the whole line was solid rock, a favorable factor in the saving of time and costs.[15]

FIGURE 148
Army engineers on a tellurometer traverse, 1958, accommodated on a Hudson Bay Railway train.

Surveying operations established a maximum gradient of 1.75 per cent, compensated for curvature, and a maximum rate of curvature of 10 degrees except for a few curves in the line approaching the Churchill River bridge, which were somewhat sharper. Such steep gradients and heavy curvatures are uncommon in railway location work but were adopted in this project to enable construction to be accomplished at a minimum capital expenditure in relation to volume of available traffic and to anticipated cost of operation.

As an integral part of the entire undertaking, buildings in the town of Sherridon as well as heavy mining equipment were moved by tractor trains over winter trails to Lynn

Lake. Rails reached that community on October 23, 1953. The new mine there came into production in that same year. The last spike ceremony, featuring President Donald Gordon of the Canadian National Railways, took place on November 9, 1953, followed by the loading of the first railway car with nickel concentrates for shipment to the Fort Saskatchewan refinery in Alberta.

During the period of 20 years following the end of the Second World War more than 2,000 miles of new railways were built in Canada. This construction effort was spurred by the nation's remarkable industrial growth during that span of time, especially in relation to mining and to the pulp and paper industry.

The development of Canada in general has been influenced to a marked extent by engineers who located the nation's railways. These men and the surveyors who assisted them were not only animated by a vigorous, resourceful, pioneering spirit but possessed as well the vision and optimism indispensable to the opening up of vast new regions. The building of the Hudson Bay Railway, for instance, brought fresh impetus to the surveying of base lines and of meridians, particularly in northern Manitoba; just as the construction of the Canadian Pacific Railway in the late 1870s and early 1880s imparted a dynamic drive and sense of urgency to the subdivision of lands in Canada's western interior. From 1911 to 1917, for example, no less than 1,852 miles of base lines and meridian lines were surveyed in Manitoba's north.

The time-tested uses of barometer, transit, level and chain were no longer the principal means by which location and subsequent railway surveys could keep pace with the rate of progress demanded by fast-moving developments. These tools, by the 1950s, had become less significant for these purposes than precision cameras, air photographs, electronic distance measurers, first-order plotting instruments and the thin chattering vanguard of an army of computers. Fortunately, progress in aerial mapping and in map production techniques generally had advanced to the point at which accurate planning of railway construction could be expedited greatly.

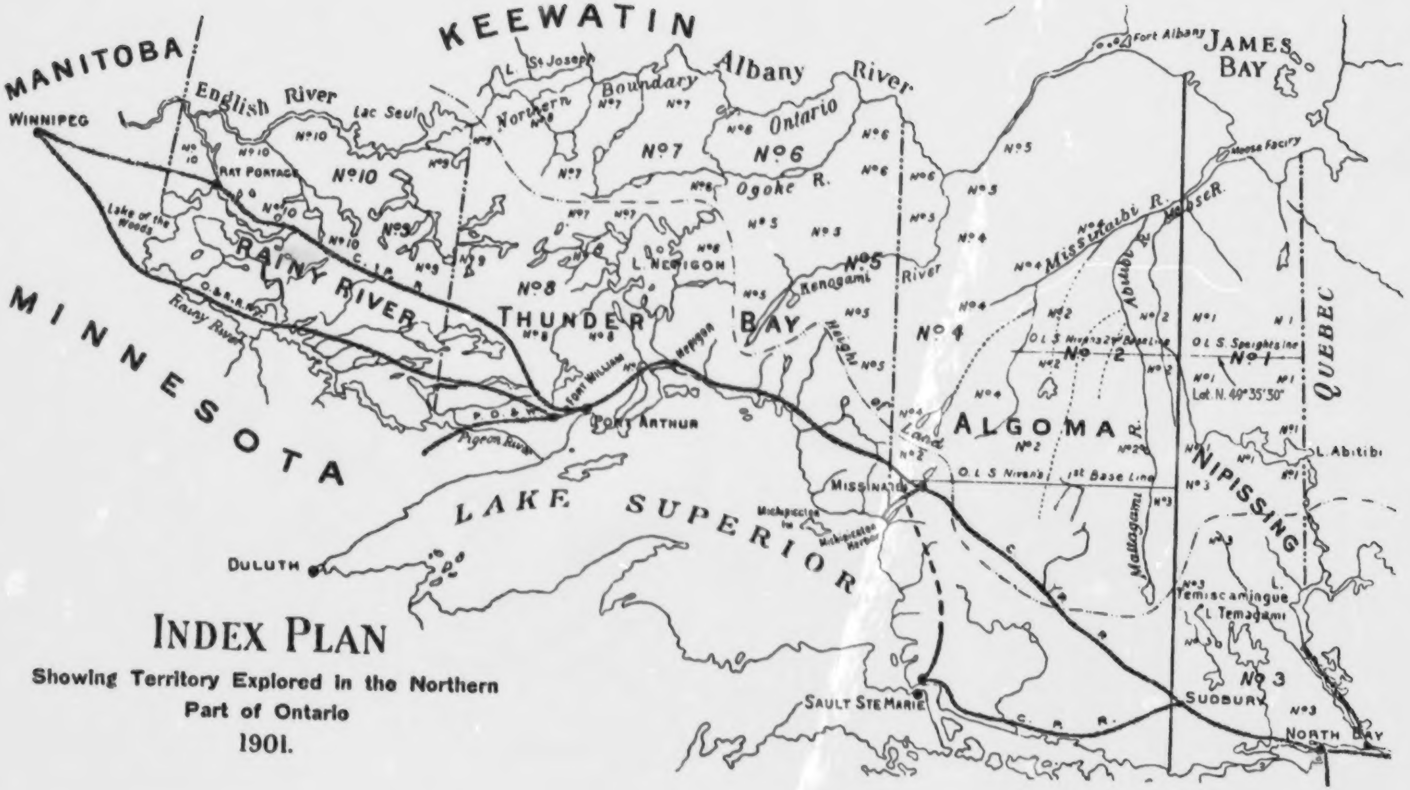
18

THE ROLE OF MAPPING IN FOREST SURVEYS

The term "forest surveys" has the advantage of brevity but the disadvantage of ambiguity. As the term has been employed in Canada such surveys resemble population or special audience types of census-taking rather than any professional surveying in the traditional sense. But forest survey work in Canada in the earliest days of this activity was performed basically for the production of planimetric mapping, information assembled more often for private lumbering or pulpwood firms than for governments or for the use of the general public. Because of its mapping aspects, however, a review of this service to a major industry of this country is relevant, if not quite indispensable, to the story of surveying and mapping in Canada.

Forest surveys or tree counts of the 19th century and the early 20th century in this country were performed by timber cruisers. These durable men, possessed of a special talent for the purpose, "cruised" or walked the woods searching for trees suitable for the production of masts for Royal Navy vessels. Later their reconnaissance work broadened to include timber useful in ship construction and for the production of squared logs. The ability to roam forests and make reliable, accurate estimates of the number of masts and useful logs obtainable from specified areas, as well as their probable dimensions, called for the exercise of special training, skills and good judgment.

One of the pioneer timber cruisers in Canada was Titus Smith, Jr., a land surveyor who, in 1801, at the request of the government of Nova Scotia, toured what was then the interior wilderness of that province to discover and report upon, among other matters, "the quality of the land and the character of the timber, especially that suitable for masts . . ." Smith performed his ambitious survey entirely by foot, equipped only with a compass, rough map of the general area and a small supply of food. The map that he produced as a result of his strenuous tour represented an important milestone in resources mapping and in resources inventory work in the northern half of North America.[1]


INDEX PLAN
Showing Territory Explored in the Northern Part of Ontario
1901.
KEEWATIN
MANITOBA
MINNESOTA
LAKE SUPERIOR
JAMES BAY
QUEBEC
THUNDER BAY
RAINY RIVER
ALGOMA
NIPISSING
WINNIPEG
DULUTH
PORT ARTHUR
FORT WILLIAM
RAT PORTAGE
MISSINABIE
SAULT STE MARIE
SUDBURY
NORTH BAY
English River
Lac Seul
Albany River
Ogoke R.
Kenogami River
Missinaibi R.
Abitibi R.
Moose R.
Mattagami R.
L. Nepigon
L. St Joseph
L. Abitibi
L. Temiscamingue
L. Temagami
Lake of the Woods
Rainy River
Pigeon River
Fort Albany
Moose Factory
Northern Ontario Boundary
Height of Land
No 1
No 2
No 3
No 4
No 5
No 6
No 7
No 8
No 9
No 10
O. L. S. Speight's line
O. L. S. Niven's 2nd Base Line
O. L. S. Niven's 1st Base Line
Lat. N. 49° 35' 30"
C. P. R.

MAP 12. Territory covered by resources survey under Ontario government auspices at the turn of the century.

In 1900 one of the most remarkable explorations and reports to be made on this continent for the purpose of presenting data on natural resources over a wide area was undertaken at the request of the government of Ontario. The investigation was prompted by an urgent need for authoritative information on the natural assets of northern Ontario, to enable members of the Legislature of the province to vote intelligently on the nature, size and number of government expenditures that ought to be made for the development of that part of Canada. Accordingly ten field parties were organized and, with one exception, each party was placed in charge of an Ontario land surveyor. The lone non-surveyor party chief was George R. Gray, who was in charge of Party No. 3. Even so, his party included Ontario land surveyors Richard W. DeMorest and George E. Silvester. The land surveyor chiefs, in order of their numbered parties, were Thomas B. Speight, Alexander Niven, Alexander Baird, Walter S. Davidson, Joseph M. Tiernan, Hume B. Proudfoot, David Beatty, James Robertson, and John McAree.

FIGURE 149. Thomas B. Speight.

The official who recommended the over-all scheme of organization for the expedition was the then Director of Surveys for Ontario, the Dominion and Ontario land surveyor George B. Kirkpatrick, who had been asked by the premier of the province, Hon. George W. Ross, to take on that task and to submit an estimate of the cost of such exploration. With the help of information supplied to him by the Department of the Interior and by the Geological Survey in Ottawa, Kirkpatrick arranged for the preparation of a map on a scale of four miles to the inch, showing what was then known of the territory to be examined. Kirkpatrick's estimate of cost was $40,000 and this was the sum actually voted by the Legislature for the purpose. It stands as a tribute to Kirkpatrick's accurate forecasting that the eventual total expenditure on the enterprise amounted to $40,518.28.[2]

Among the duties to be discharged by field parties on this expedition was the compilation of reports on pulpwood resources in the areas explored, on the basis that spruce and poplar formed the principal sources of that product. "It was necessary that the explorations should be performed", the completed report stated, "so that the country could be mapped out and the situation of the good land and timber accurately laid down on the plans of the Crown Lands Department."[3] In addition to a land surveyor each of the ten field parties included a geologist and a timber expert so that, in addition to any required mapping, reports could be prepared on the nature of mineral wealth, water-power potentialities, varieties of soils and extent of pulpwood and timber resources in the entire region.

Apart from the categories of information already mentioned, data was asked on the flora, fauna and fish of northern Ontario. In addition the government sought a description of the general features of the region, procured by a track survey of water communications. Observations were to be taken, at regular intervals, for latitude readings and for magnetic variations.

The total assignment was a most formidable one. Some conception of the work to be accomplished in the course of this single field season of five months may be derived from a description of the limits of the region to be covered by Party No. 5 under Davidson, namely: "Jackfish Station on Lake Superior to Long Lake, then down the Kenogami River to Albany River, then down the Albany River to Hudson Bay. The English River to be explored for 20 miles on each side and the Albany River by way of any large streams flowing into it from the south." Each chief of party was equipped with a theodolite, a pocket sextant, steel tape and pins, compass with Jacob's staff, a micrometer, customary plotting instruments, aneroid barometer, camera with films, tin box for field books and drawing materials and a tin case for preserving specimens of the flora of the country. This in addition to tents, canoes and pack-straps ". . . all to be returned and accounted for."

The report resulting from this ambitious enterprise, published in the following year, 1901, is a classic of its kind and represents, in resource mapping and in the gathering and presentation of resource information, an achievement seldom equalled anywhere in the world. On a small budget Dr. B. F. Fennow accomplished a somewhat similar but much more restricted survey of Nova Scotia in the field seasons of 1909 and 1910.

In 1912 the consulting firm of Lyford, Clark and Lyford prepared a remarkable survey, including the production of maps on a scale of 20 chains to the inch, of the Petawawa timber limits of Gillies Brothers of Braeside, Ontario. These maps were contoured and, despite poor ground control, proved highly accurate.

As a consequence of the growing scarcity of traditional timber cruisers the *valuation survey* became an established procedure and foresters concentrated on the percentage of the particular forest that needed to be tallied as well as on the most effective width of strip or size of sample plots, in order to provide a satisfactory degree of accuracy in their estimates. Often during such a forest study it was essential to produce a reliable planimetric, if not a topographic, map as well as a reliable estimate of timber volume. The network of base lines, run mostly with a staff compass, formed the skeleton on which the map was assembled. Since staff compass lines were of relative accuracy only, transit lines had to be run at wide intervals where cadastral surveys did not extend into the region. Parallel cruise lines, usually at 20-chain intervals, were run between base lines and along these lines topography was mapped and trees tallied.

Aerial Photography and Forest Surveys

Some of the first non-military aerial photography performed in Canada was in support of forest studies. Maps, of course, are aids indispensable to the success of such investigations. Soon after the end of the First World War, pulp companies in Canada expanded greatly. Timber cruisers, men trained in the long tradition of the craft, were few and difficult to find. In addition, these specialists felt that pulpwood surveys were beneath their proud notice. But the companies, now in possession of large timber limits, desperately needed reliable maps of their properties. Such maps, in fact, were required to form the basis of any systematic forest survey.

At about this stage of developments the airborne camera came to the aid of the forestry and pulpwood industries. In 1919 a forester, Elwood Wilson, persuaded the federal Department of Marine to lend to the St. Maurice River Protection Association, of which he was president at the time, two Curtiss naval flying boats of the HS 2L type. In return for the use of these planes Wilson was to submit to the government at Ottawa reports on work accomplished in air photography.[4] Capt. Stewart Graham, with his wife acting as navigator, flew one of the loaned planes to Lac à la Tortue near Grand'Mère, Quebec. Wilson went along in order to observe and assess progress on the venture. He had purchased a small hand camera for taking photographs from the air. In addition Wilson had ordered a large automatic camera for use in air mapping. The 1919 season was so successful for this enterprise that in the following year the federal and Quebec governments established a seaplane base at Roberval.

In 1919 also a little-publicized but highly significant pioneer expedition was organized by a Canadian with the aid of United States capital and some American personnel to undertake an aerial survey in what is now part of Canada. Capt. Daniel Owen (1890-1939) of Annapolis, later Annapolis Royal, Nova Scotia, served as leader of the expedition. Owen had served in the First World War as a pilot in the Royal Flying Corps. In an encounter with enemy aircraft in France Owen's plane was shot down. He lost an eye in the crash landing and was taken prisoner by the Germans. In the postwar project Owen was backed financially by the Southern Labrador Pulp and Paper Company, Inc. of Boston, Massachusetts. A group of about 20 men was organized for the purpose of accomplishing an air survey of the Labrador timber limits leased by this American firm. The limits, about 2,500 square miles in extent, formed a tract in the vicinity of Battle Harbour, St. Louis Inlet and Alexis Bay. H. V. Greene Aerial Survey Company Limited of Canada came into existence primarily to assist in the Labrador project. But by mid-summer of 1919 the firm actively sought contracts "to photograph and survey timber, pulpwood and water areas, cities and towns" in all parts of the United States and Canada "or any part of the world".[5]

For use by this Labrador expedition, which included five pilots, a forester and two surveyors (Charles Whitman of Annapolis County and Peter Hatfield of Yarmouth), special techniques were practised in Annapolis County. It was the summer of the popular visit to Canada of the youthful Prince of Wales. Newspaper front pages in the Maritimes reflected in column after column public absorption with the royal personage and his activities. But this general preoccupation with parades and pageantry failed to erase entirely from the public press some lively descriptions of the Owen expedition.

On July 7, 1919, *The Morning Chronicle*, Halifax, carried an item under an Annapolis, Nova Scotia, dateline of two days earlier, "First Aerial Expedition in World.

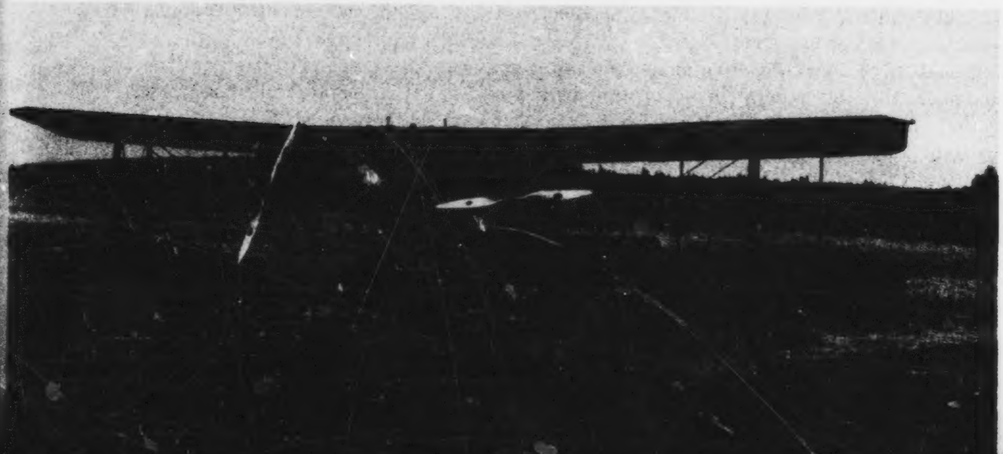
Everything in Readiness for Departure for Labrador." The text of the despatch read, "The expedition to explore by airplane the timber resources of Labrador, planned by Dr. Murdoch M. Graham of Boston, has materialized and is expected to sail tonight or tomorrow in the steamer *Granville*. The deck of the vessel, under command of Captain I. C. Rhude, has been fitted to carry an airplane and a seaplane with wireless equipment installed. This expedition will have the distinction of being the first of its nature for commercial purposes. It is expected to accomplish in six weeks by aerial reconnaissance of wooded areas in Labrador what would otherwise take six years to accomplish. The expedition, estimated to cost $200,000, is expected to lead to the development of new sources of supply of wood and pulpwood."

The front page of *The Morning Chronicle* of July 8 bore the heading "Expedition Off for Labrador. Steamer *Granville* Sailed From Annapolis Last Night." Then the text, "A large crowd was on the wharf to see them off and they were heartily cheered as the steamer left the dock. This afternoon a picture was taken of the party which will be shown on movie picture shows." The entire survey operation, in which two Curtiss JN4 planes were employed, was completed in 10 days of flying that summer. Airborne crews were divided into two shifts so that full advantage could be taken of the long hours of daylight available in such latitudes at that season of the year. Photography was carried out at altitudes ranging from 2,000 to 9,000 feet. About 5,000 gallons of gasoline, in addition to supplies of oil, were required.

On August 23, 1919, *The Morning Chronicle* displayed a bold but somewhat misleading heading, "Expedition Returns and Reports Having Explored Millions of Acres" over a despatch from Curling, Newfoundland, dated the previous day. In part the text read, "Cruising in airplanes over Labrador millions of cords of pulpwood could be cut and rolled to streams for direct shipment, members of the expedition which spent the past month there, said today . . . Pictures were taken from the air, numbering 13,000, were said to show dense growth of pulp material in readily available locations. The use of the airplane was looked upon as opening a new field for commercial aviation. The planes cruised inland for more than 100 miles. Captain Daniel Owen, Royal Flying Corps, head of the expedition, and other members of the party left tonight for Boston."

Photographs produced by the survey expedition apparently were taken direct from Newfoundland to the headquarters of the firm in Boston by Capt. Owen. During the years following the expedition and until the year of his death Owen practised law in Annapolis Royal, becoming a King's Counsel. For several years he served as mayor of that town. As far as can be ascertained the air photographs taken by the 1919 expedition to Labrador have not been used in the production of maps available to Canadians.[6]

FIGURE 150. Vickers planes were used in the 1920s in Canada for oblique photography of large areas. This Vickers-Vancouver type is at Waskesiu Lake, Sask.



Probably the first attempt, on a fairly large scale, to utilize aircraft and aerial photography in central Canada for forestry purposes was in 1921. In May of that year the Ontario Department of Lands and Forests assembled three HS 2L flying boats on the shore of Pelican Lake at Sioux Lookout. Familiarization flights commenced at the end of that month. During regular operations, which continued until October, vertical and oblique photographs were taken. Landings were made to enable the flying foresters to inspect each of the forest types, to take sample plots as well as ground photographs. Flights were then made in the region over blocks of timberland about which the provincial government required not only information prior to offering same for sale but complete forest-type maps as well. The greatest problem facing the foresters during the operation was the lack at that time of satisfactory base maps of the area being flown. Large expanses, dotted with lakes, appeared only as blanks. Such lakes had to be sketched in, before forest types could be portrayed and, as a result, mapping of waterways consumed about two-thirds of the total time devoted to the enterprise. Despite all difficulties, forest-type maps and descriptive reports covering about 15,000 square miles were completed. Most of the region covered was north of the Canadian National main line and to English River, Lake St. Joseph and upper Albany River and from the boundary with Manitoba east to a point just beyond the town of Armstrong.[7]

In the years between 1925 and 1930 several thousands of square miles were vertically photographed for the Quebec government and for pulp and paper companies, practically all of it in the province of Quebec.

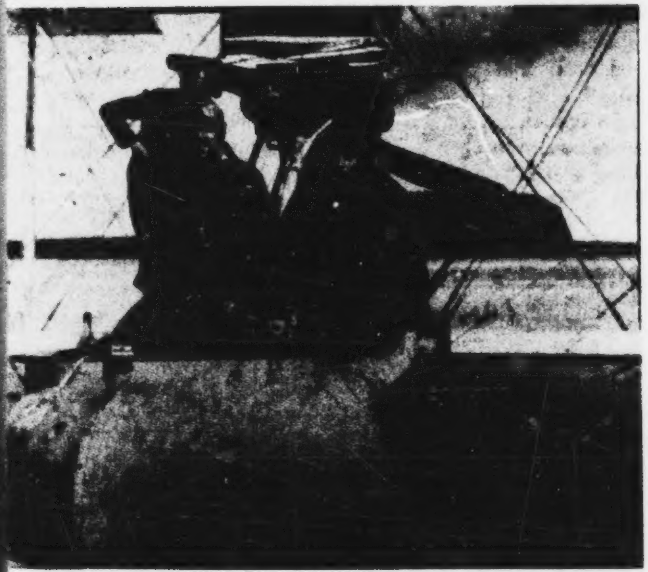


FIGURE 151
Paul Savard, Q.L.S. (left) with pilot and forest engineer Jean G. Rivard, Q.L.S. This Curtiss HS2L plane was used to expedite surveys of part of Hamilton River watershed, 1926.

In 1923 the government of Ontario entered into a three-year contract with Laurentide Air Services for air surveying and mapping of forestry resources in that province. An airbase for the company's HS 2L planes was established at Sudbury and sketching-observer teams for the operations were provided by the Department of Lands and Forests. The sketchwork was done by foresters trained in the art. In each instance the forester directed the course of the plane by a set of pre-arranged signals from the forward cockpit, which he occupied, to the pilot. The task of the forester in flight was to sketch required detail on the best available topographical map of the district being flown. A reliable and detailed forest-type map could thus be produced. At the time, these maps were utilized mainly in forest protection work.

In 1927 Frank T. Jenkins of James D. Lacey and Company (Canada) spoke to the Canadian Society of Forest Engineers and reported that during the six or seven years since aerial mapping had come into existence in this country, and apart from aerial photography, approximately 120,000 square miles of Canada had been mapped by the sketching method.

Jenkins had joined the Lacey Company on graduation and later became its managing director. In 1924 the firm added to their forest engineering service the sketching method of aerial forest mapping. In three seasons beginning that year the firm sketched about 30,000 square miles in Ontario, Quebec, Manitoba, and Nova Scotia. A ground cruising party operating in the sketched area would find such maps invaluable although, where ground control was scanty, tiny lakes would not be represented in the sketching owing to the time factor involved.

In his 1927 address to the forest engineers Jenkins went on to say: "Assuming there is sufficient control, sketch the area as intensively as possible. With this map and the descriptive report, plans can be projected in the office . . . All that remains then is to apply the average per acre figure, as shown by the strip tallies, to respective types."[8]

In this statement the method outlined by Jenkins, in basic form, continued to be that most used in forest-cover mapping during the era following the end of the Second World War. In earlier days of aerial mapping of forests, sketching was accomplished from the cockpit of the plane. Map sections were mounted on beaverboard and one of the first duties that the sketcher had to perform was to check his maps against the country to be represented in order to determine what detail was reliable. The sketch map was oriented to the country and the sketching was carried on by a rough triangulation system. When the forester had sketched the main waterways, intervening details and forest types were added.[9]

In 1927 to 1929 a pulpwood survey took place in Manitoba involving a notable application of aerial mapping to forest survey work. The Manitoba Paper Company, before building a projected pulp mill at Pine Falls on the Winnipeg River, decided to make certain of the existence of a continuous supply of wood for that operation. Air photographs, taken by the Dominion Forest Service, mostly obliques, covered much of Manitoba lying directly east of Lake Winnipeg. There had not been sufficient time to prepare forest-cover maps of the area and so field parties subsequently made use of these photographs frequently in order to locate areas of forest and to cruise same.[10]

Under such pioneering conditions field investigations consisted of surveying a few strip cruise lines through major blocks of timber, utilizing air photographs for control. This procedure speedily provided a reconnaissance survey of a vast area. In 1933 Gerald S. Andrews, then of the Forest Surveys Division, British Columbia Forest Service, and Lyle G. Trorey published an article on the use of aerial photographs in forest surveying. This presentation proved to be a significant contribution to Canadian progress in forest surveying and mapping methods.[11]

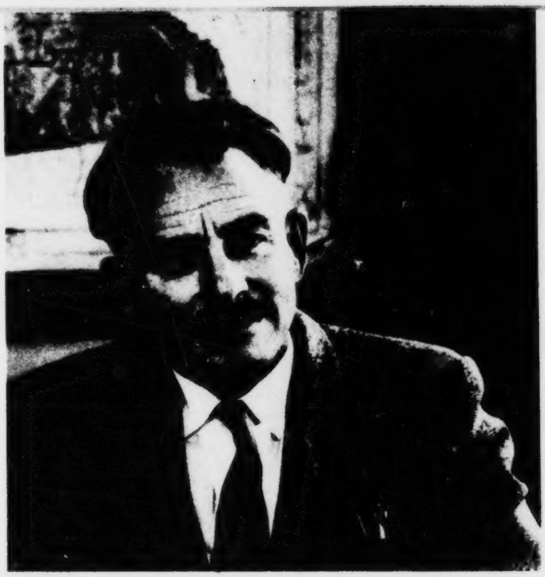


FIGURE 152. Gerald S. Andrews.

For a year, including parts of 1933 and 1934, Andrews was occupied in Europe on a partly foundation-financed study of air survey developments from a forestry standpoint. His studies were carried on in the United Kingdom and, particularly, at the Tharandt Forest School in Germany. Following his return to Canada, Andrews wrote an article, published in this country, descriptive of German photogrammetry and air-photo interpretation procedures as applied to forest surveys.[12] In his article Andrews pointed out that in the intelligent use of aerial photography a revolutionizing aid had been found in advancing systematic descriptive mapping and appraisal of forested areas, including the Canadian method of mapping from obliques. In Germany world-famous industries had grown up, engaged in the manufacture of optical and scientific instruments of high precision. These industries had devoted special attention to the development of photogrammetrical instruments and techniques and to the application of these to air survey work generally. Andrews felt that although unmodified German methods in this field could not be applied to Canadian conditions the Europeans had provided valuable object lessons as well as clues to better procedures in Canadian forest inventory work. Canadians, however, had advanced far beyond any European experience in the qualitative interpretation of air photographs. Andrews warned that the resulting map should not become an end in itself. "The map", he declared, "is only an important contribution to the main end, namely, the efficient use and administration of the country concerned. In the case of a forest survey the map is an indispensable document but, after all, accessory to the real purpose of the survey."

Although another Canadian forester, H. E. Seely, had perfected a system of measuring the height of trees from the length of their shadows as depicted on air photographs, Andrews devised a system of measuring tree heights by parallax, a method suited to mountainous terrain such as that found in British Columbia. The determination of the total height of any tree or stand of trees represents a most important step in the appraisal of uncut timber because the cubic contents of the tree bole is related to its height. The Andrews system was based on micrometer measurements of the difference in parallax between the top and bottom of any tree revealed on stereo-pairs of vertical air photographs, correlated with factors of the plane's altitude, length of air base, and focal length of the airborne camera lens.[13]

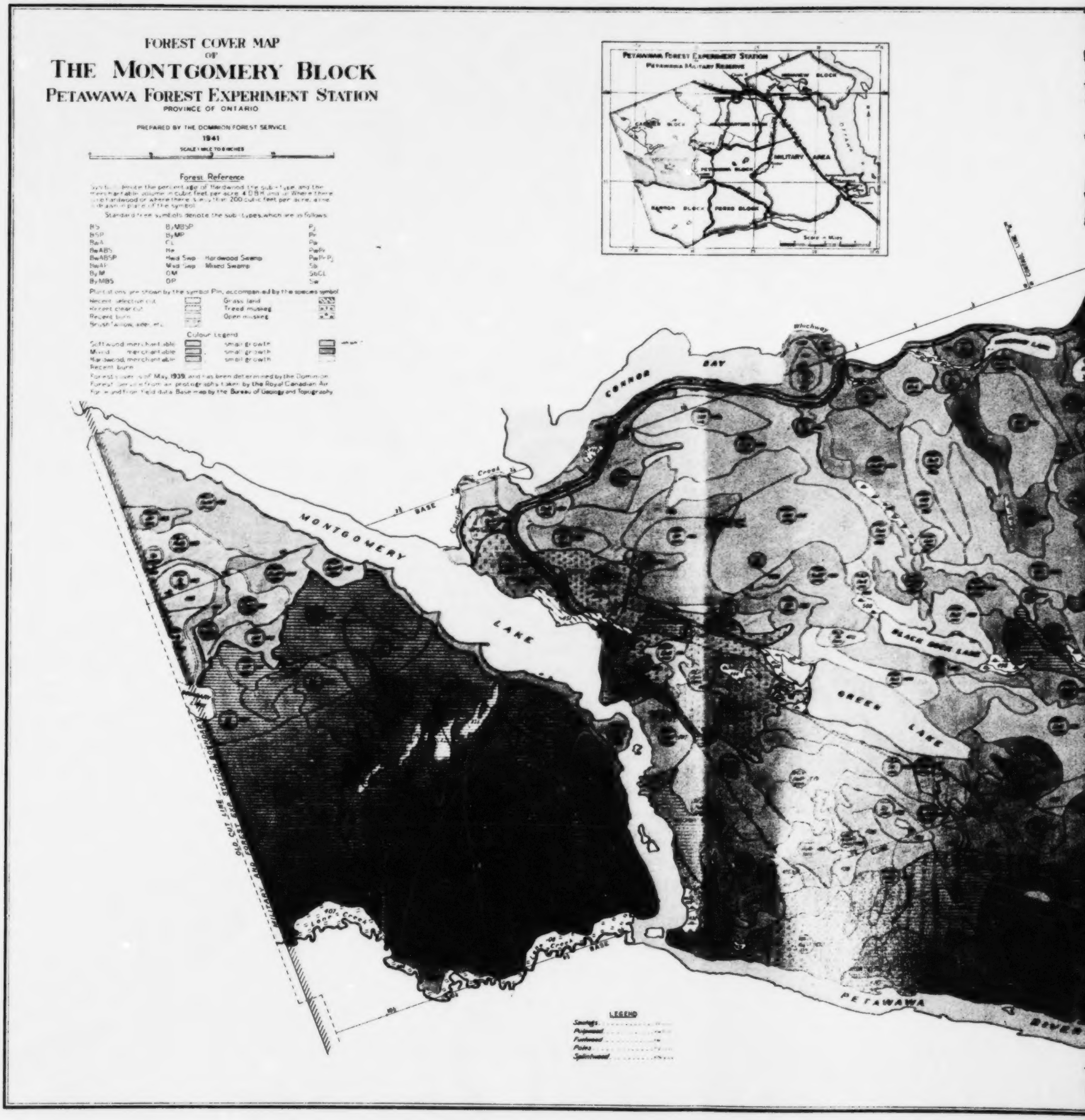
FIGURE 153
Interpretation of forest detail in airphotos.

The Dominion land surveyor, C. B. C. Donnelly, in his writings for *The Canadian Surveyor,* shed an informative light on procedures followed during the depressed 1930s in the conduct of winter surveying with relief labor in this country.

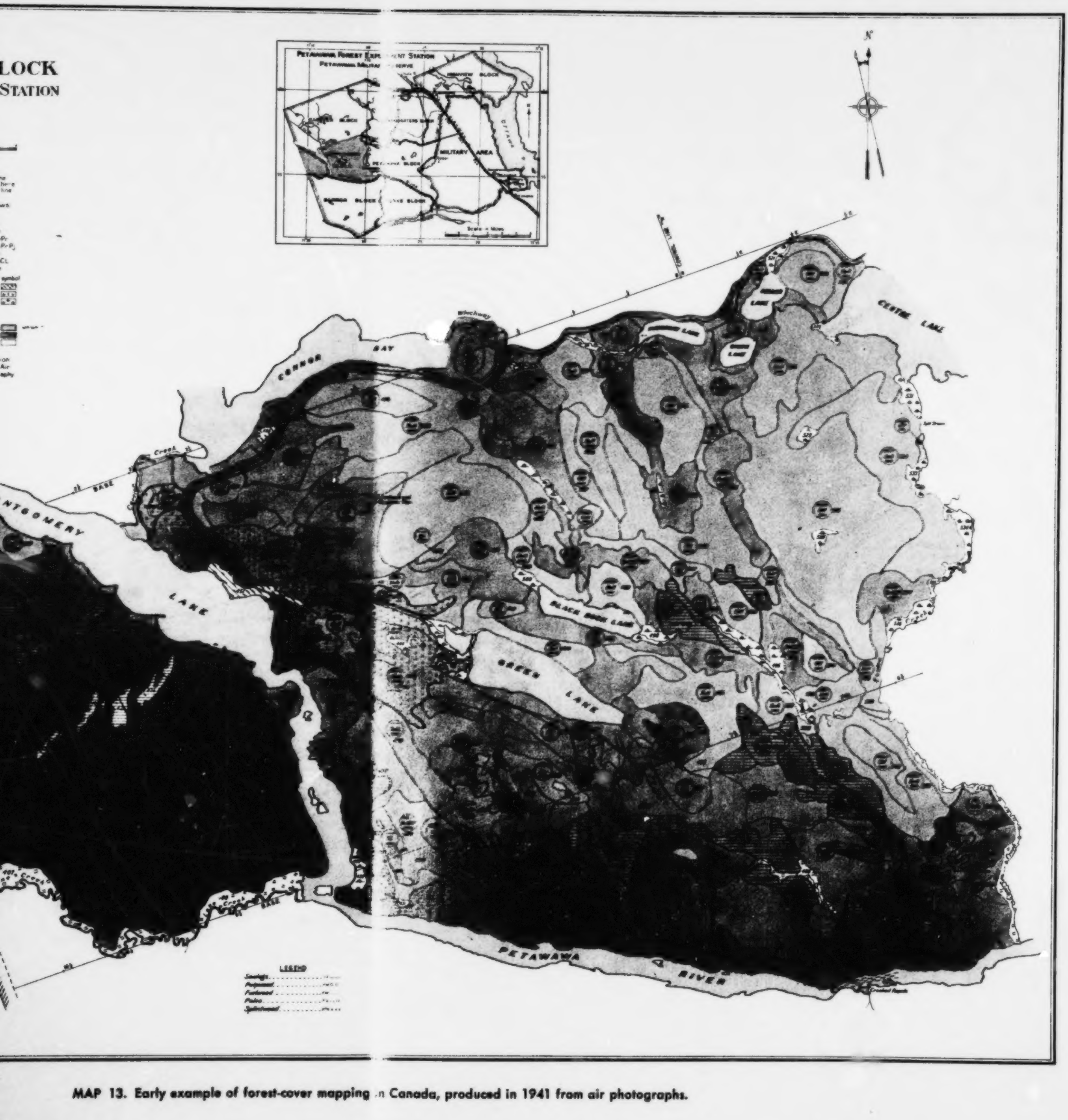
"Last winter [1934-35]", Donnelly stated, "the Dominion Forestry Branch, Department of the Interior, received an area of about 36 square miles for experimental purposes, out of Duck Mountain Forest Reserve. As these lands had been acquired by Manitoba under the transfer of natural resources to the provinces, and as the survey was a function of both federal and provincial governments, instructions were drawn up by the Surveyor General [federal] to accord with the provincial regulations of survey, as enforced by the Director of Surveys for Manitoba.

"Actual work [by a field party of 18 men] commenced on February 9th and ceased on May 31st. The total mileage surveyed came to sixty, which for the period averages one-half mile per day. The maximum daily output was two miles, the minimum was ten chains. It was arduous work travelling on snowshoes through the dense growth which characterizes this area . . . In many places thickets were so dense that axemen had to clear a path before a transit could be carried through . . . Posts were cemented in temperatures of 50 below zero . . .

"Embodied in the Surveyor General's instructions for the survey was an aerial map prepared from vertical photographs of the area. Before leaving for the field I supplied myself with the vertical photographs in question. In addition I carried a collapsible field stereoscope. A comparison of the map and measured line crossings of distinct topographical features revealed an accuracy in the map that is amazing. I do not believe the maximum error exceeded a few chains. The timber typing was particularly well plotted. I was thereby able to guide the [railway] tie makers to areas suitable to their needs . . . The photographs were particularly useful in cross-country walking to and from work, locating trail and daily routine uses. It is possible to trace a path from tree to tree by use of such photographs, that is, where the cover is fairly open. Identification on the


FOREST COVER MAP
OF
THE MONTGOMERY BLOCK
PETAWAWA FOREST EXPERIMENT STATION
PROVINCE OF ONTARIO
PREPARED BY THE DOMINION FOREST SERVICE
1941
SCALE 1 MILE TO 8 INCHES
Forest Reference
Standard tree symbols denote the sub-types which are as follows
BS
BSP
BwA
BwABS
BwABSP
BwAP
ByM
ByMBS
ByMBSP
ByMP
CL
He
Hwd Swp Hardwood Swamp
Mxd Swp Mixed Swamp
OM
OP
Pj
Pr
Pw
PwPr
PwPrPj
Sb
SbCL
Sw
Grass land
Treed muskeg
Open muskeg
Recent selective cut
Recent clear cut
Recent burn
Brush (willow, alder, etc.)
Colour Legend
Softwood merchantable
Mixed merchantable
Hardwood merchantable
small growth
small growth
small growth
Recent burn
Forest cover as of May 1939 and has been determined by the Dominion Forest Service from air photographs taken by the Royal Canadian Air Force and from field data. Base map by the Bureau of Geology and Topography
PETAWAWA FOREST EXPERIMENT STATION
PETAWAWA MILITARY RESERVE
BLOCK
MILITARY AREA
PETAWAWA BLOCK
BARRON BLOCK
FORD BLOCK
Scale in Miles
Whitney
CONNOR BAY
Creek
BASE
MONTGOMERY
LAKE
BLACK DUCK LAKE
GREEN LAKE
OLD CUT LINE
Long Creek
PETAWAWA
RIVER
LEGEND

MAP 13. Early example of forest-cover mapping in Canada, produced in 1941 from air photographs.


LOCK
STATION
PETAWAWA FOREST EXPERIMENT STATION
PETAWAWA MILITARY RESERVE
MILITARY AREA
N
CENTRE LAKE
CONNOR BAY
Birchway
NTGOMERY
LAKE
BLACK BASS LAKE
GREEN LAKE
PETAWAWA
RIVER
BASE
Creek
LEGEND

MAP 13. Early example of forest-cover mapping in Canada, produced in 1941 from air photographs.

photographs of individual trees, small rills and openings is possible when one's position is pin-pointed. Many section and quarter-section corners were positively identified on the photographs. Mr. G. Tunstell of the Dominion Forestry Branch located proposed roads on the photographs by the use of the stereoscope, and subsequent delineation on the ground, in conjunction with the aerial map, showed remarkable correspondence."[14]

Early in 1937 a major manufacturer of paper in England employed Canadian Airways Limited to undertake an aerial photographic survey of timberland in the lower Hamilton River region, Labrador, property in which the paper company was interested as a possible source of raw material supply. The survey, in which mapping played a minor role, was to be completed between spring break-up and winter freeze-up.

Jenkins, who by this time was assistant manager of Canadian Airways, was responsible for the planning of the operation. His past experience in the region to be surveyed proved to be most valuable. In 1935 Jenkins had carried out an aerial forest reconnaissance covering all of Labrador where pulpwood might be expected to occur in commercial quantities. During that reconnaissance he had prepared a sketch map of the main

FIGURE 154. Spruce growing under nurse crop of poplar near Upper Manitou Falls, English River.

waterways and forest types across 42,000 square miles. Using two Bellanca Pacemaker planes equipped with floats, each carrying a Fairchild K3 camera unit, the 1937 air survey was completed successfully in the course of 76 hours of photography, spread out over the period from June 24 to September 15. The project covered, in all, 2,150 square miles and 261 miles of control lines. Timber cruisers for the English firm, using joined photographs taken on a scale of 1,000 feet to the inch, produced a rough map judged useful for their particular purposes. The entire enterprise was the first wholly self-sustained aerial photographic operation carried out by Canadian Airways Limited.[15]

In 1937 also the Dominion Forest Service utilized winter oblique and summer vertical photographs in the preparation of a forest-cover map of Riding Mountain National Park in Manitoba. In the following year forester John M. Robinson, using only air photographs, prepared a detailed forest-cover map of a New Brunswick area. Estimates per acre were inserted by Robinson on each delineated stand of timber. In addition, land elevations were denoted and gradients indicated by slope arrows.

In the earlier years of its progress in Canada the art of aerial photography was employed mainly in forest studies rather than for mapping purposes only. With the advent of fast panchromatic film and improved lens filters research was directed more and more towards the production of superior mapping by the use of aerial photography. The experience gained overseas by Andrews in the mid-1930s and the resulting new concepts which he and others introduced in the New World exercised a profound, progressive influence upon forest surveying and mapping in British Columbia in particular and in Canada generally.

During the inter-war period the struggle to introduce and develop aerial surveys in Canada, on a private enterprise basis, was not an easy one. In 1930 the federal government ceased to let contracts for its air survey work to commercial companies because of the economic depression and the more limited budgets of governments. The private firms, after purchasing equipment to handle anticipated government contracts, found themselves with a surplus of equipment. The Quebec government, which had carried on a program of aerial surveying of forest resources for some years, also suspended its program in 1932. The ensuing years were difficult for air survey companies in this country but in 1935 and 1936 the Geological Survey of Canada contracted for some of its aerial survey work. This assistance enabled commercial firms to bridge a critical period and helped to maintain, in the private sector, the nucleus of a Canadian aerial surveys organization.

Despite the relatively small volume of aerial survey work carried on in Canada during the lean years this testing period was one of advancement in the techniques of such mapping methods, particularly in the realm of forest inventory and forest geography. Sound foundations were laid at the time for a more extensive use of aerial surveys in this country in years to come.

19

THE CANADIAN EIGHT-MILE MAP IN PEACE AND WAR

In January, 1946, the American Geographical Society, New York City, announced with considerable satisfaction that a new series of maps portraying Hispanic America had been completed under its auspices. The 107 sheets of the series covered all of South and Central America. Much prominence was given in the broadcast programs and in the press of this hemisphere to this highly commendable achievement, a project that had engaged the energies and resources of the Society for 25 years. Yet two years previously, without fanfare, a mapping project of much greater magnitude had been completed in less than five years by Canadian government agencies. Early in July, 1944, the large press of the Hydrographic and Map Service, Ottawa, was printing hundreds of copies of the final map of the 221-sheet series of Canada's eight-mile (to the inch) Air Navigation series, covering several million square miles. Publicity on this project, through the needs of wartime secrecy, had been drastically curtailed. Nevertheless this prodigious task, accomplished despite numerous technical problems, shortages of materials, depleted staffs and the exacting deadlines of urgent wartime requirements, stands as one of the superlatively great Canadian achievements in the realm of mapping and charting.[1]

In one sense, however, the development of this impressive mapping project had its real genesis almost 20 years earlier. During the decade immediately following the end of the First World War the need to provide greater uniformity in the maps being produced in Canada became fully apparent. What was required was a new, more comprehensive system of mapping the entire country at standard scales. Finally, in 1927, the National Topographic System (N.T.S.) was established after an earlier but abortive attempt to bring it into existence. Under its provisions sheet sizes were allotted for maps at scales of 2, 4, 8 and 16 miles to the inch, as well as at 1 mile to the inch. Here at last was a means by which a suitable series of systematized and standard topographic base maps, covering all Canada, could be constructed on a continuous, orderly basis, with each sheet fitting its neighbors on all sides and with all sheets drawn to the same scale and same specifications. The adoption of this new system constituted a great stride forward in the process of solving Canada's most challenging mapping problems. Prior to this scheme Canada's topographic maps had been issued by several federal government departments and each map-producing agency had its own mapping standards. In the result the sheets had appeared in a variety of styles, sizes, shapes and scales. The N.T.S., as it came to be known, not only provided uniformity of technical factors but also a ready method of map indexing and map reference. Such a system, in fact, was indispensable to any extended, efficient mapping program in this country and, as matters turned out, to the development of Canadian air navigation charts for peacetime and wartime uses.[2]

Not long after the end of the First World War Canadian aviation authorities began thinking in terms of air navigation charts to guide pilots using the air lanes of this country. As early as 1920 the Dominion Geographer was requested to commence preparation of aeronautical maps on the system laid down in the International Air Navigation Convention. The formidable nature of the undertaking was recognized in the official comment accompanying the request, namely, "The process of completing the mapping of Canada on this system will necessarily be a very long one."[3] This Canadian move was a bold one for those times but neither official records nor official correspondence disclose any significant follow-up on this decision until after a number of years had elapsed.

By 1926 the Post Office Department, Ottawa, indicated that it was ready to support the inauguration of regular domestic airmail services and in the same year the Topographical Survey (Interior) issued a chart, generally considered to be the first of its kind in this country, the Winnipeg Aeronautical Map, so styled, produced on a scale of eight miles to the inch and covering the area served by the Winnipeg Air Base of those days. The appearance of this map preceded, of course, the establishment of the National Topographic System. It was in 1926, also, that the use of eight-mile N.T.S. maps, as bases for air navigation charts, was first considered at the official level.[4]

It was obvious by this time that in the near future the Topographical Survey would be called upon to compile and to print air navigation maps for the use of the Royal Canadian Air Force. On April 3, 1929, a letter was received by Deputy Minister Cory of the Department of the Interior from Deputy Minister Desbarats of the Department of National Defence. In this letter the military requirement of the menacing years ahead was foreshadowed in the following terms, "The need for such [air navigation] charts is growing and I shall be glad if you would authorize officers of your department to discuss their production with officers of the Air Service so that the most desirable types of maps may be decided upon and the scale of the maps, the symbols and other details may be settled."

Unlike the United States of America, Canada did not possess the financial resources to make possible the construction and printing of two distinct sets of maps, one topographic and the other aeronautical. This nation had to attempt to satisfy a wide range of interests, including that of air navigation, by means of one basic type of map, using at the outset the technique of overprinting air information on a variation of the topographic base map.

Soon after 1931, when the first civilian-produced N.T.S. eight-mile map, the Winnipeg Lake sheet (63 S.E.) was issued in Ottawa, serious consideration was being given by mapping authorities in the Canadian capital to the formation of a long-range policy covering production of air navigation charts. The Winnipeg Lake sheet, and the

English River sheet (52 N.W.) prepared soon afterward, were made by direct reduction of drawings for four-mile maps. The advent, in 1927, of an airmail delivery service in Canada along various routes led to a demand for strip (air navigation) charts, each sheet a representation of the topography from airport to airport. Such charts were, in fact, issued in 1930 and 1931 and constituted pioneer attempts to meet a pressing, rapidly-growing need at the time. Only the western Canadian strip charts, however, were produced on the eight-mile-to-the-inch scale.

The standard series of eight-mile maps for all Canada was conceived and planned in the course of conferences with officials of the Geographical Section, General Staff (G.S.G.S.) but later a number of maps were prepared covering a portion of the Trans-Canada airmail route. As these sheets were required urgently they were designed and produced quickly. The production of the eight-mile series was under the general direction of the Topographical Survey, the G.S.G.S. working to the Survey's requirements. The usual map legends and headings of the N.T.S. were adopted and whenever compilation and printing was done by the G.S.G.S. this fact was indicated by a footnote.[5]

In the summer of 1932 Surveyor General Peters had reached the conclusion that the eight-mile topographic map must perform a dual function and "whatever information is required for air purposes will be added as an overprint . . ." This decision was followed a year later by a request from Controller of Civil Aviation J. A. Wilson to Topographical Survey for air navigation charts, eight miles to the inch, to cover a flight strip across Canada.[6] This close cooperation between military and civilian mapping agencies in Ottawa featured the early years in the production of the eight-mile series. By early autumn of 1932 Lieut. Col. E. L. M. Burns of G.S.G.S. and his chief draughtsman Cranston were working with J. R. Akins, Chief of the Topographical Division of the Topographical Survey, Bruce W. Waugh and chief draughtsman Birchall in the production of eight-mile N.T.S. maps and charts. They had agreed generally on what land features ought to be depicted on such sheets, what conventional signs ought to be employed as well as on the selection of standard forms, type sizes and colors for the various printings.

In a communication from Burns to Peters the former made some interesting observations in regard to the eight-mile series, "I am not satisfied that we have produced an entirely satisfactory style for this. It seems to me to be a little overloaded with detail, especially where rural post offices and townships are shown, as you consider necessary. It will, of course, be a great advance when these maps are available for all Eastern Canada, a project which is now well on the way. The eight-mile scale was chosen, to some extent, because of its usefulness for aviation purposes . . ."[7]

Gradually the dual-purpose policy developed as eight-mile-to-the-inch topographic base maps were transformed into air navigation charts (initially described as 'maps') of the same scale. The transformation process, at the time, was a complicated one but in the main consisted of three stages: the topographic base map; the skeletonized version of that map and, thirdly, the edition to that version of overprinted air information to constitute the air navigation chart. The point made by Burns for the removal of unnecessary clutter from the topographic sheet in the adaptation process, was a valid one. A first consideration in the production of an aeronautical chart is that it should not be overcrowded with irrelevant details. All information should be presented clearly and often, boldly. The use of small type-face in nomenclature and in other map descriptions should be scrupulously followed. Much detail considered essential to a topographic edition was obviously superfluous to the air navigation edition, information such as the names of many small towns, township boundary lines and rural post offices. Water features, however, were to be outlined with clarity. Cities, railway lines, airfields, meteorlogical and broadcasting stations, radio range stations, beacons, highways as well as important relief were included, the latter emphasized in hypsometric tints, portraying elevations by means of colors.

By the end of 1933 Peters announced that his organization had on hand "the following eight-mile sheets on which we intend to make an overprint of aids to air navigation, namely, Upper Ottawa River, Toronto-Ottawa, Ottawa-Montreal, Megantic, Fredericton-Moncton and Charlottetown-Sydney." Of these the Ottawa-Montreal and Megantic sheets were the work of the G.S.G.S. In 1935 the Fredericton-Moncton sheet became the first eight-mile-to-the-inch (overprint) air navigation chart to be issued in Canada with its sheet lines conforming, at least partially, to the National Topographic System.

Early in 1937 the newly-created federal Department of Transport actively entered the domain of air charting as a consumer and part-time policy maker. This development resulted from the establishment in April of that year of Trans-Canada Air Lines. The new department made known to the Department of Mines and Resources and, through it, to the Surveyor General of Canada, the chart requirements of pilots of the fledgling air lines system. In negotiations that followed A. M. Narraway for the Surveyor General and Major Robert Dodds for the Department of Transport, acted as intermediaries. Special emphasis was laid on chart coverage of the main flight route of the system, east to west in this country. It was the eight-mile-to-the-inch scale of charting that was required here also — "the project is of major importance to the success of the operations of the new Trans-Canada air system."[8] The Department of Transport and the Royal Canadian Air Force collaborated closely with the Legal Surveys and Map Service of the Department of Mines and Resources to establish initial mapping standards.

The second dominant development in this period that profoundly influenced the course of Canadian mapping and charting activity, especially on the eight-mile-to-the-inch scale, was the creation of the British Commonwealth Air Training Plan. The operations of this scheme, established in Canada at the outset of the Second World War, made a contribution toward the final victory of the forces of freedom, the dimensions of which cannot easily be overdrawn or overestimated. It was at this turning point in world history that the wisdom of the selection by Canadians of the eight-mile-to-the-inch scale for the air navigation charts of this country, became clearly evident. A larger scale of mapping would have required an increased number of chart sheets to cover any designated area and, correspondingly, more charts for any specified air route, adding inconvenience to a pilot operating within the limited accommodation of a cockpit. When the wartime plan for training allied pilots in Canada was established the urgent, rapidly-mounting demand under that scheme was for eight-mile-to-the-inch aeronautical charts. This need dovetailed perfectly, not to say miraculously, into the production advances already made in this country on that particular scale of mapping and charting.

The wartime challenge to the Legal Surveys and Map Service, Ottawa, was one of the most staggering proportions. Printing presses in the possession of that organization had seen their best days. Their output was limited by hand-operated feeds and by frequent mechanical breakdowns. Camera equipment was inadequate. In the years of economic depression severe reductions of staff had occurred, with resulting losses of experienced, talented men. To help meet the sudden need for trained personnel a number of superannuated civil servants were induced to return to the federal service.

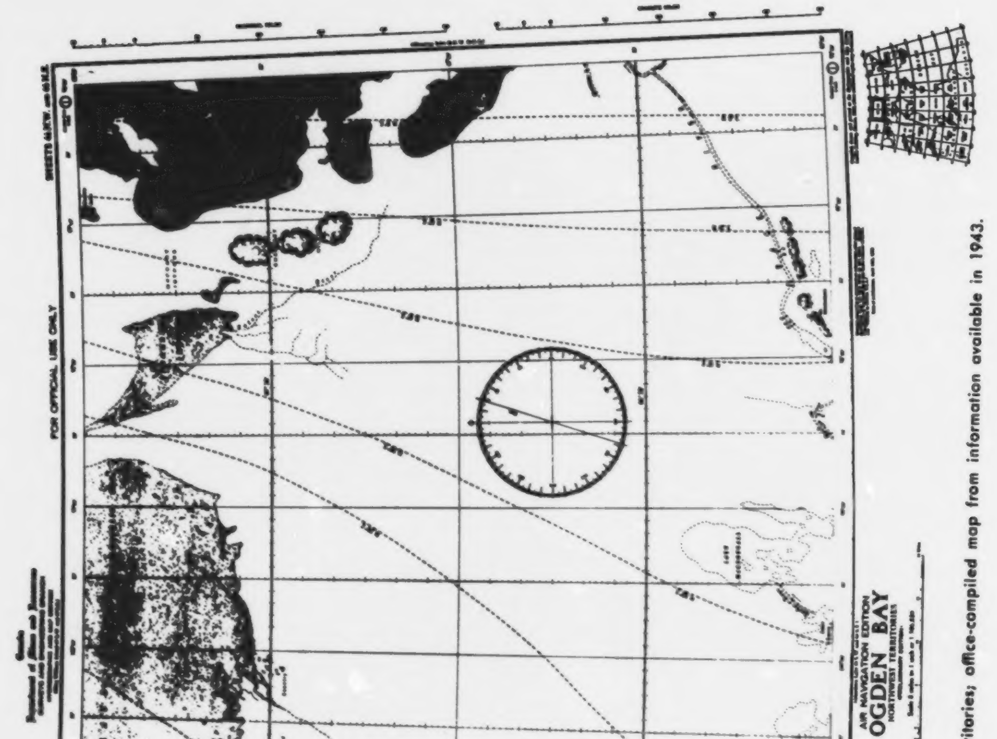
With their important assistance all newcomers to the staff were given extensive instruction.

FIGURE 155. Bruce W. Waugh.

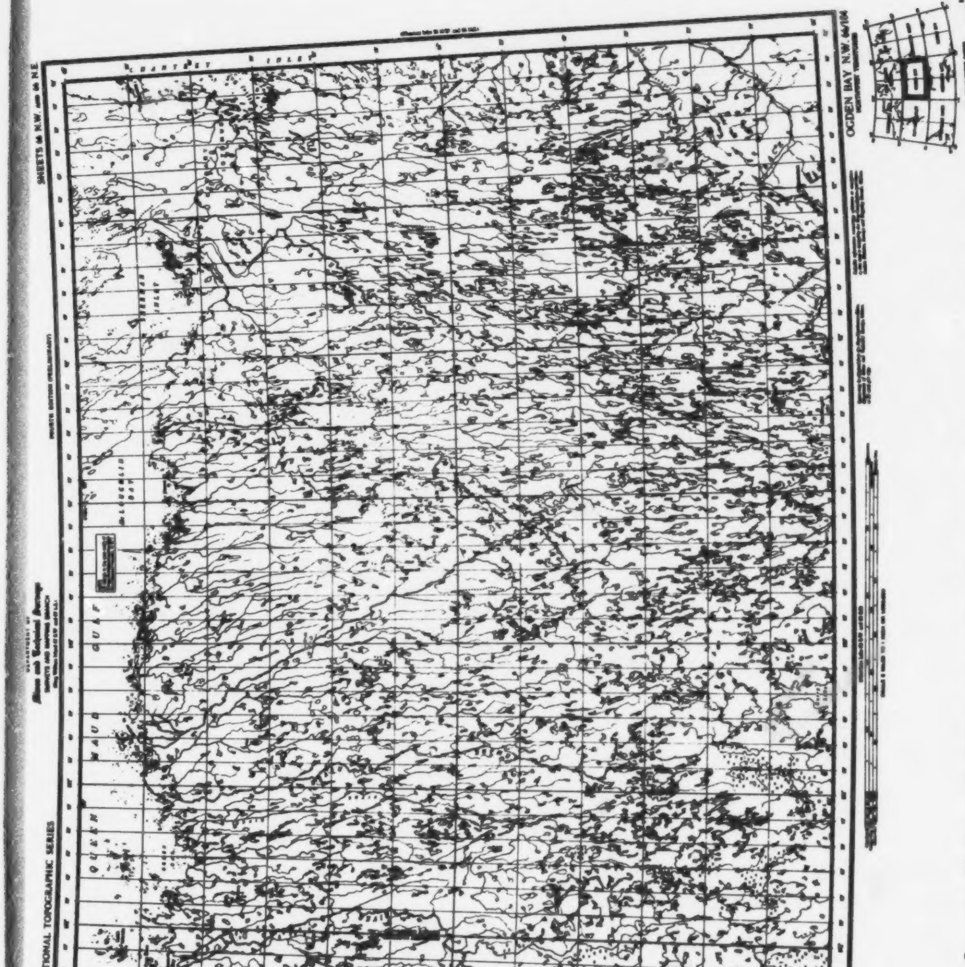
FIGURE 156. Maxwell Cameron.

Three civil servants at Ottawa, in particular, gave inspiring leadership in the course of discharging heavy responsibilities related to production of eight-mile maps and charts. F. H. Peters and Bruce W. Waugh contributed to the success of these efforts in almost equal measure with Max G. Cameron making a vitally important contribution involving the assembling of topographic information essential to the compilation of maps of the then unsurveyed territories of Canada's North. In this task he was assisted by Dominion land surveyor Cecil Barnwell Coslette Donnelly (1889-1966) on loan at the time to the Geodetic Survey of Canada from the Legal Surveys organization, Ottawa. Donnelly made astronomical observations in the northland to enable map compilers to position their data properly. Pilots of flying boats carrying Cameron and Donnelly risked destruction of their craft time and again as landings were made on open water in icy inlets and bays along the Arctic coast. In this way the topographer and geodesist were able to reach shore where the latter kept bone-chilling nightly vigils, peering into his instruments at the frosty stars.

In addition to holding a Dominion land surveyor's commission Donnelly was qualified to practice in Manitoba and Alberta. He was familiar with the northland and had assisted, about the mid-century mark, in surveying boundaries of Wood Buffalo National Park. As early as 1928 Donnelly wrote for publication on the use by the Topographical Survey (Interior) of a navigating sight for aerial photography.[9] Donnelly,


NATIONAL TOPOGRAPHIC SERIES
FOR OFFICIAL USE ONLY
AIR NAVIGATION EDITION
OGDEN BAY
NORTHWEST TERRITORIES

MAP 14. Ogden Bay area, Northwest Territories; office-compiled map from information available in 1943.


N.W. OGDEN BAY
NATIONAL TOPOGRAPHIC SERIES
QUEEN MAUD GULF
OGDEN BAY N.W.

MAP 15. Ogden Bay area, Northwest Territories; map resulting from trimetrogon photography, published 1953.

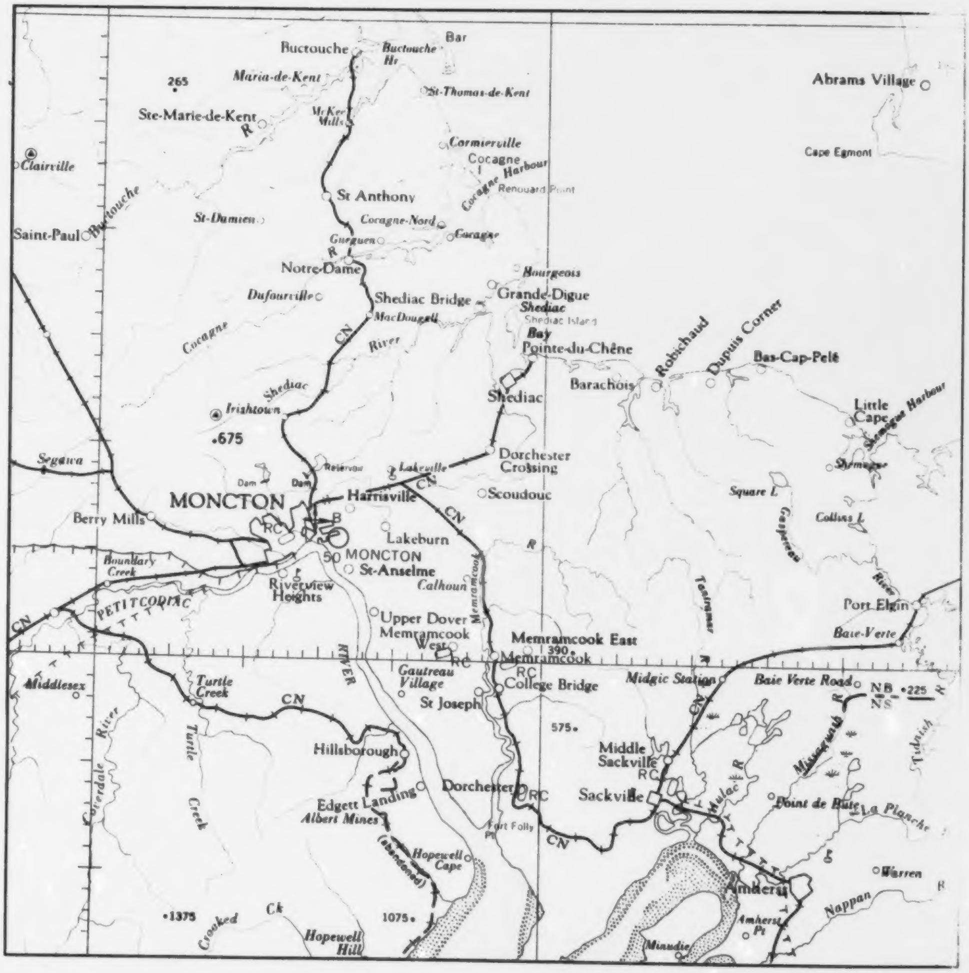
in addition to possessing ability as a surveyor, was a gifted writer of poetic prose. On one occasion, reminiscing in the columns of *The Canadian Surveyor,* he recalled a memorable photographic survey flight north of the Arctic Circle. "Fascinated by the sensation of flying over terrain that remained as nature had fashioned it," he wrote, "we winged into the mellow twilight of the Midnight Sun. Far ahead the icefields of the polar seas gleamed in a ghostly after-glow. We were mapping a vast unexplored country. Hidden in the fold of a timbered valley on the banks of a stream, its impetus hushed by Great Bear Lake, was our camp lying under the shadow of the great mineralized vein, 80 miles long, on which was located the famous silver radium deposits of Eldorado. From the air the broad white seam is like an ancient Roman road, a gleaming ribbon undulating with the inequalities of hill and dale, to dip eventually into the lake, visibly reflected from its clear blue depths when its surface is unruffled."[10]

Cameron was exceedingly diligent in his research in the field of derived mapping on the eight-mile-to-the-inch scale. He assembled all information available on the topography of the area to be charted. In some instances this meant that maps had to be draughted on the basis of data more than 100 years old! Geographical knowledge, gained by the numerous searchers for the lost Franklin Expedition, was consulted with meticulous care as were Admiralty charts of Arctic waters and primitive sketches made by explorers and prospectors. The location of a lonely trapper's cabin at the junction of rivers in an untracked wilderness was more important to the construction of these pioneer aeronautical charts and their users than the location of a large city on an air map portraying heavily populated areas of the nation.

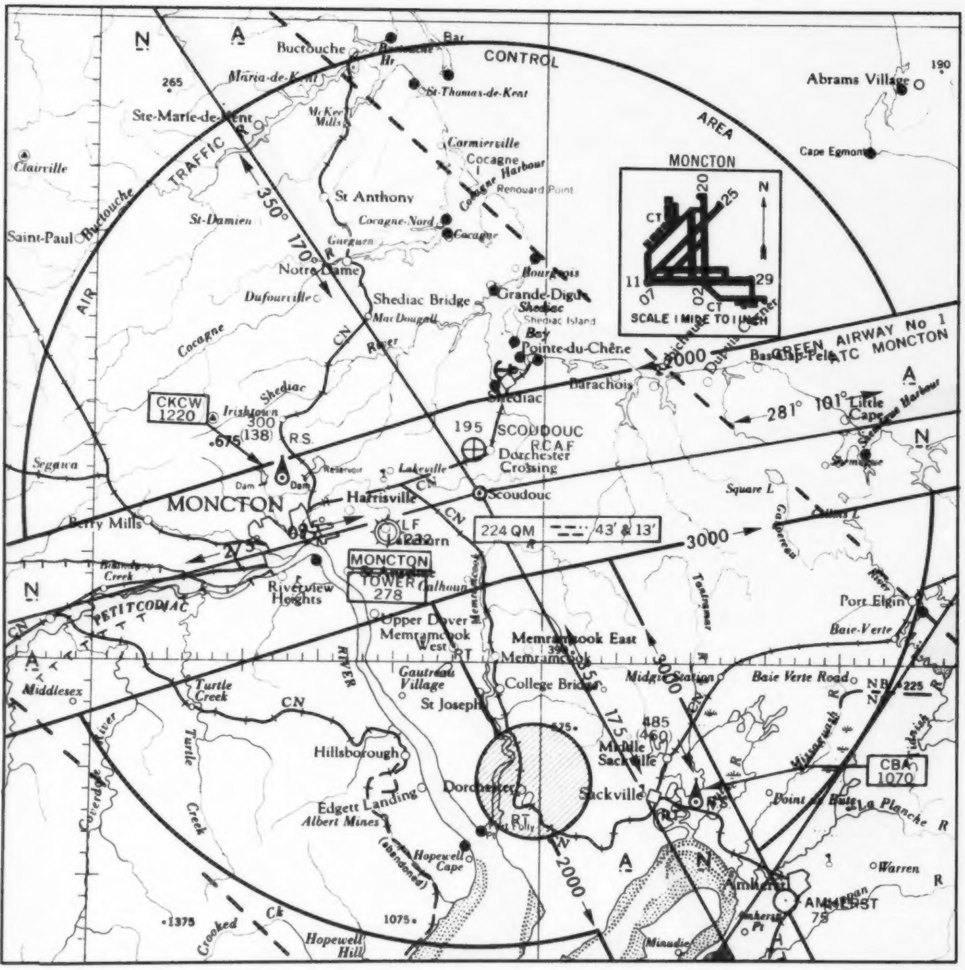
Provincial departments cooperated to the full in this enterprise. Department of Transport officials contributed invaluable air navigation data. The Royal Canadian Air Force provided a steady flow of suggestions based on analyses of various flight reports. The U.S.A.F. and R.C.A.F. maintained a constant supply of air photographs for map and chart compilers in Ottawa. As rapidly as new information reached the draughtsmen these documents would be revised, after the new data had been sorted, screened and then reduced or enlarged, as required, to the proper scale.

The presses owned by the Department of Mines and Resources were inadequate to carry the immense new loads placed upon them. In the emergency, G.S.G.S. equipment was put to this use as was that of a private commercial printing firm. For a normal peacetime year at this stage of Canada's growth the Royal Canadian Air Force might make use of about 200 copies a year of any required piloting chart. Under the British Commonwealth Air Training Plan the demand for each sheet of such charts rose initially to 1,000 copies annually, then to 20,000 copies. In the case of plotting charts the amount reached 190,000 copies in each year of the war. In the peak final year a total of 1,830,000 map sheets, or an average of 6,000 copies each working day, were printed and distributed for all purposes by Legal Surveys and Map Service.[11]

This wartime experience demonstrated that a strictly civilian organization could be geared rapidly and effectively to meet the special stress and demanding needs of military map production. The Air Navigation Chart series stands as a notable cartographic achievement, both in compilation and production, of which Canadians may well be proud. The eight-mile air charts were not only indispensable aids to the war effort of the allies, they proved invaluable in post-war commercial flying, including the tapping and developing of Canada's natural resources. To a great extent the expanded wartime demand for maps and charts continued into the years of peace. While distribution dropped to below the abnormally high wartime levels, the demand from all sources


Buctouche
Buctouche Hr
Bar
Maria-de-Kent
265
St-Thomas-de-Kent
Abrams Village
Ste-Marie-de-Kent
McKee Mills
Cormierville
Clairville
Cocagne
Cocagne Harbour
Cape Egmont
Renouard Point
St Anthony
St-Damien
Saint-Paul
Cocagne-Nord
Cocagne
Gueguen
Notre-Dame
Bourgeois
Dufourville
Shediac Bridge
Grande-Digue
Shediac
Shediac Island
MacDougall
Bay
Pointe-du-Chêne
Robichaud
Dupuis Corner
Bas-Cap-Pelé
Barachois
Shediac
Irishtown
.675
Little Cape
Shemogue Harbour
Segawa
Dorchester Crossing
Lakeville
Shemogue
MONCTON
Harrisville
Scoudouc
Square L
Berry Mills
Collins L
Lakeburn
50 MONCTON
St-Anselme
Boundary Creek
Calhoun
Riverview Heights
PETITCODIAC
Port Elgin
Upper Dover
Memramcook West
Memramcook East
Baie-Verte
Memramcook
390
Middlesex
Turtle Creek
Gautreau Village
College Bridge
Midgic Station
Baie Verte Road
NB
NS
.225
St Joseph
575.
Hillsborough
Middle Sackville
Edgett Landing
Dorchester
Sackville
Albert Mines
Point de Bute
La Planche
Fort Folly Pt
Hopewell Cape
Warren
Amherst
Nappan
.1375
Crooked Ck
1075.
Hopewell Hill
Amherst Pt
Minudie
CN
RC
R
B
Turtle Creek
River
Coverdale
Memramcook
Tantramar
Gaspereau
Missaguash R
Aulac R
Tidnish R
Dam
Reservoir
(abandoned)

MAP 16. Part of map (Fredericton-Moncton sheet) showing air information, 1935.



CONTROL AREA
AIR TRAFFIC
MONCTON
SCALE 1 MILE TO 1 INCH
GREEN AIRWAY No 1
ATC MONCTON
CKCW 1220
MONCTON TOWER 278
224 QM
SCOUDOUC RCAF
CBA 1070
AMHERST
Buctouche
Ste-Marie-de-Kent
Shediac
Cocagne
Memramcook
Sackville
Dorchester
Hillsborough
Port Elgin
Abrams Village
Cape Egmont
Riverview Heights
Harrisville
Lakeville
PETITCODIAC
350°
170°
281°
101°
3000
2000

MAP 17. Same area, showing air information, 1947.

remained at a level six to eight times greater than the total for all types of maps distributed prior to the Second World War.

The transition from war years to times of peace was featured by the creation of the Provisional International Civil Aviation Organization (PICAO) in Chicago by a conference beginning late in 1944. Under this world organization a map division was set up, a function of which was to lay down specifications for all aeronautical charts required for the safety of air navigation on a world-wide basis. These steps led to the establishment of ICAO which held its first meeting in Montreal in 1947 when definite specifications were drawn up and approved in connection with a chart series for contact or visual piloting. One chart of that series relating to Canadian territory, the Athabasca River sheet, was published in 1946. Total requirements to cover Canada in that series amounted to 68 sheets, many of them descriptive of the northland. Selection of Montreal as the international centre of civilian aviation administration testified to the prominent place of Canada among the nations in the realm of aeronautical charting and to the vigorous interest and activity of this country in aviation generally.[12]

Leading Canadian geologists praised the usefulness of the eight-mile topographic maps in the advancement of their work. K. G. Chipman recorded his view that in providing general or reconnaissance knowledge of the whole of Canada "the most suitable maps for this purpose are considered to be those of one inch to eight miles, whose primary purpose has been as aeronautical charts but which will serve as reconnaissance maps for civilian users." His colleague, Dr. George Hanson, also commented that "by mapping on an eight miles to the inch instead of the four-mile scale several times the speed can be obtained [in mapping the Canadian Shield]. All of the unmapped parts of the Shield should, therefore, be mapped as quickly as possible on the eight-mile scale."[13]

Deputy Minister H. F. Gordon of the Department of National Defence for Air paid eloquent tribute to the performance of Canadians in wartime mapping and charting when he wrote as follows in a letter to his opposite number in the Department of Mines and Resources:

"The Hydrographic and Map Service of your department is to be highly complimented for their excellent cooperation with the Mapping Branch of this [military] Service and for their accomplishment in providing the Royal Canadian Air Force with hundreds of thousands of maps and air charts during the past five years, without which the British Commonwealth Air Training Plan and the Home War Operations could not have functioned.

"The excellence of the accomplishments of these two branches can well stand as a lesson in what can be achieved through the wholehearted cooperation between various departments of government operating in the same field of endeavor . . ."[14]

20

FINDER OF ALBERTA'S BLACK GOLD

" . . . so rich a bottom here."
—*King Henry IV* (1), Act 3, Sc. 1.

In February, 1947, Leduc No. 1 oil well blew onto the front pages of many newspapers of the western world. That discovery ushered in a new era in the industrial history of Canada, a period in which the resources of mineral fuels disclosed beneath the earth's surface in our western interior made this nation second in energy sources among countries of the western hemisphere.

On the face of things it might appear highly unlikely that the discoverer of the first site in Alberta of a well productive of crude oil or, as it is sometimes described "black gold", would turn out to be the son of a distinguished Clerk of the Canadian House of Commons. It is surprising also that the place of discovery should happen to be located in what is now Waterton Lakes National Park, a placid, impressively scenic region tucked in among the foothills of the Rocky Mountains close to the boundary between Canada and the United States. The element of plausibility grows, however, when it is recalled that the pioneer mainly responsible for the first successful drilling for oil in Alberta was a land surveyor of distinction, namely, Allan Poyntz Patrick (1849-1948).

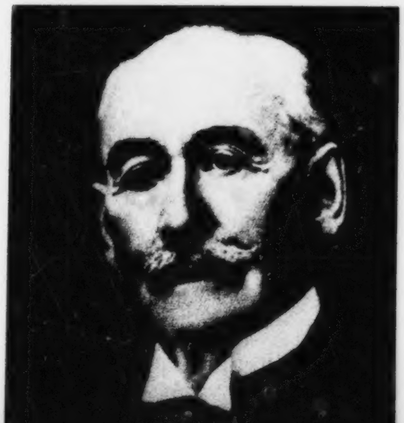


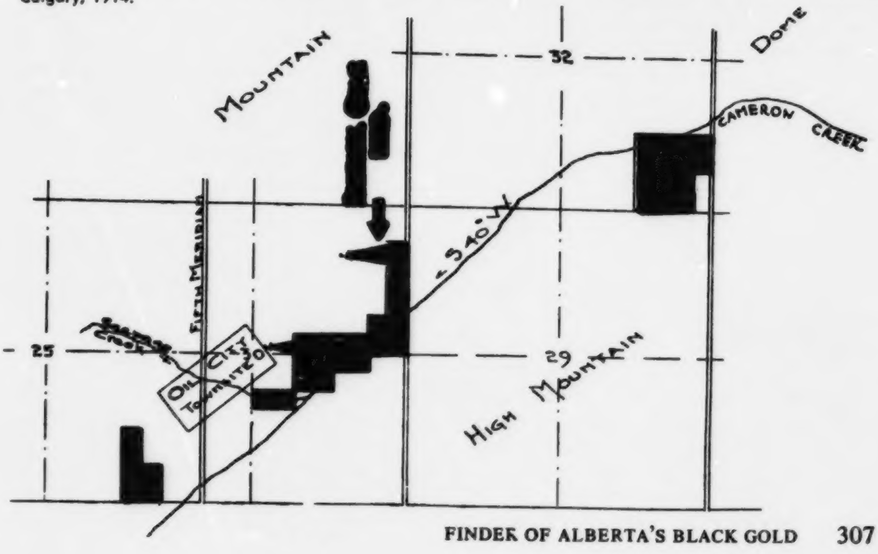
FIGURE 157. Allan P. Patrick.

It is a coincidence worth notice that the historic find was made on what came to be called Cameron Creek named, as were nearby Cameron Lake and Cameron Falls, after the commissioner in charge of the British-Canadian survey party engaged in the 1870s in delineating and marking the international boundary line from the Lake of the Woods to the Rockies.

Son of Alfred P. Patrick, C.M.G., Clerk of the House of Commons, Ottawa, up to 1877, Allan Poyntz Patrick was born in Montreal on July 18, 1849. Educated at Upper Canada College young Patrick qualified for his preliminary certificate that enabled him to practice surveying in Ontario following a training period during which he was articled to Robert Sparks, P.L.S., of Ottawa. In 1874, at the age of 25, Patrick took part in survey work in Manitoba under Lindsay Russell, soon to become Surveyor General of Canada. Patrick also participated in exploratory survey work for the Canadian Pacific Railway, north of Lake Superior. On November 19, 1877, Patrick was commissioned a Dominion land surveyor as well as certified as a Dominion topographical surveyor.[1]

During this period of his life Patrick's health was frail. On doctor's orders, in the year following his dual achievement, Patrick travelled to a part of the North-West Territories now known as southern Alberta. Soon he was thriving on rough fare and a vigorous life outdoors. On instructions from Ottawa he began a topographical survey of a large tract of land extending from Highwood River to Waterton. In the course of this lonely task he struck up a friendship with Lafayette French, a trapper and trader. One day in an Indian encampment the two men came upon an injured boy whose leg was improperly bandaged. On closer examination they found that the wrapping cloth was soaked in oil. Apparently the substance had been used by a squaw convinced of its healing qualities. Patrick and his companion realized at once the significance of this revelation. But there remained the task of tracing the oil to its source. Only after considerable argument and the trading to the Indians of food and a rifle was the squaw induced to guide the two white men to the place where the crude oil had been obtained.

FIGURE 158. Sketch map, site of Discovery well, Patrick properties. From Sinclair and Allan Prospectus, Calgary, 1914.



At the end of a prolonged search, oil seepages were found along the banks of the mountain stream known then as Oil Creek, later as Cameron Creek. That was in the summer of 1878.[2]

In those early days in the West Patrick and his friend found it difficult to arouse any active interest in their discovery. Neither could John George "Kootenai" Brown, well known as a pioneer rancher in the Waterton area. Brown was content to skim oil globules from the creek's surface and to use the substance for lubricating farm machinery and as lamp fuel. For a period of time one of his enterprising ranch hands collected sufficient oil from seepages along the creek to sell the product to nearby ranchers at a dollar a gallon.[3]

For ten years Patrick persisted in efforts to interest drillers, or men with capital, in his find near Waterton as well as to attract the attention of authorities in Ottawa in its possibilities. At this time Dr. A. R. C. Selwyn was Director of the Geological Survey of Canada. Patrick persuaded him to visit the southwest corner of what is now Alberta in order to assess its oil production potentialities. In the 1890-91 annual report of the Geological Survey, Ottawa, Dr. Selwyn reported on his findings in regard to a section of land some eighteen miles south of Pincher Creek. He mentioned in that report that he had visited the site "of a proposed boring, on July 20, 1891, on a small flat on the left bank of the tributaries of the Waterton River." On the following day Selwyn found "nothing whatever to indicate the existence of petroleum in this vicinity. It seems highly improbable that it should be found here, though, of course, not impossible. Heard later that a copious flow of water had been struck and the boring abandoned."

Finally Patrick, in 1889, filed formal claim to 640 acres in the vicinity of the discovery site. At the time there were not any official application forms pertaining to petroleum rights available at the federal office in Fort Macleod and so a form relating to quartz mining claims was adapted to the purpose.[4] In the meantime, in 1884, an English firm of bankers had filed a claim on a section of land near Twin Butte, close to Patrick's property, but drilling was not commenced there until seven years later by a corporation known as the Southern Alberta Land Development Company. After drilling to a depth of 190 feet an artesian well was punctured and the resulting flow of water forced abandonment of the hole. Oddly enough the Canadian Pacific Railway, which had so often searched for subterranean water supplies in this part of Canada, found only natural gas whereas the promoters of Twin Butte, seeking crude oil, found only water! Another hole was drilled in the vicinity of Waterton Lakes in 1893 by the same company but difficult drilling conditions prevented any significant progress being made.

Some years after these abortive attempts John Lineham, a prominent stockman of Okotoks, near Calgary, became interested in Patrick's story of his discovery. At this stage Arthur Sifton, later to become premier of Alberta, was closely associated with Lineham as was John Leeson. At the turn of the century the Rocky Mountain Development Company Limited was formed, including these men and Patrick, to develop for oil production the acreage held in the name of the land surveyor. A drilling rig, costing $680 was shipped from Petrolia, Ontario, to the site of the proposed well and operations began in November, 1901. On September 21, 1902, at a depth of 1,020 feet, the drillers struck oil. It was reported that the well began to flow at the rate of 300 barrels a day. The strike occurred in Section 30, Township 1, Range 30, West of the 4th Meridian. In honor of the event this place, 25 miles southwest of Pincher Creek, was christened, somewhat ambitiously, Oil City. But soon after the strike drillers of the discovery well began to encounter formidable difficulties. Drilling tools became lodged in the hole.

Efforts to recover the tools began immediately but were unsuccessful. Apparently drilling with cable tools had cut the well casing and, as a result, gravel poured into the hole. Steam pressure in the boiler at the well site was insufficient to dislodge the tools. Accordingly the operator tied down the safety valve to produce more pressure whereupon the ancient equipment, unable to withstand the additional strain, blew up. In addition, because of the high paraffin content of the oil the hole became cemented and this reduced the daily flow from 300 to only 40 barrels. Several storage tanks, built with a capacity of 2,000 gallons, had been filled from the well's output before operations were suspended. Operations were resumed spasmodically thereafter and by May, 1906, Lineham certified that the Patrick well had produced a total of 8,000 gallons of oil.[5]

In the spring of 1905 the Canadian Pacific Railway, curious about the spate of rumors concerning the production of this pioneer well, asked the Dominion land surveyor William Pearce to visit the site and to report on what he found there. Pearce advised the company that he had found three full storage tanks, each "holding upwards of 2,000 gallons" along with a small and rather primitive refinery.

During several years following the initial strike numerous holes were drilled in the vicinity of the discovery without any trace of oil being found. In 1907, on the advice of an eminent geologist, Dr. I. C. White, drilling in the Waterton area was discontinued and the search for black gold shifted toward Pincher Creek. Thus the "Oil City", that Patrick and his associates had so cheerfully visualized, never emerged from the dream stage. As late as 1936 a hole was drilled to a depth of 2,500 feet within a very short distance of the site of Patrick's well but no sign of oil was encountered as a result.

In the years following his initial find of oil seepages Patrick, now known to close friends as "A.P.", pursued the practice of his profession, surveying townsites of settlements located along the Canadian Pacific Railway line from Fort Macleod northward to Edmonton. In addition he became one of the first cattle ranchers in the high country south of Calgary, starting Mount Royal Ranch on the Ghost River. After participating in the field in the campaign against Louis Riel, Patrick homesteaded on a ranch he named "Holmpatrick". In these early years of western development Patrick was also kept busy surveying in Calgary and in the nearby Indian Reserves of the Stony and Sarcee tribes. In 1890 he qualified to practise surveying in British Columbia and became an Alberta land surveyor in 1911, having been entitled to carry on his profession in the

FIGURE 159. A. P. Patrick in Highwood River country, Alberta, 1925.

FIGURE 160
A. P. Patrick with a close friend, Viscount Bennett.

territories previously by virtue of being a Dominion land surveyor. From a condition of indifferent health in his youth Patrick developed great stamina and lived to an advanced age. In 1943, at the age of 94, he fell and broke a hip. But on March 4th of that year, prior to his accident, he had written to J. E. R. Ross, a fellow-member in that rare fraternity of Dominion topographical surveyors, "Am still working and have just finished a subdivision survey which has been registered without question by the Director of Surveys." At that time he was the oldest practising land surveyor in English-speaking Canada.

In the course of time Allan P. Patrick has come to be regarded generally as the father of commercial oil production in the western interior of Canada. Following the discovery at Leduc, Alberta, in 1947, Canada became a leading nation in the producing, as well as the consuming, of oil. The Imperial Oil Company's successful Leduc No. 1 well was the 134th hole to be drilled in a 20-year-long campaign, costing upwards of $25,000,000 in the search for black gold beneath the surface of the prairies. The strike imparted new impetus and direction to oil prospecting in Canada and in Alberta particularly. Whereas 62 geophysical survey teams functioned in this country in 1948, by 1957 a total of 156 such field parties were active. The annual total of such survey groups never fell below 150 in the interval between those years. During that same period the number of producing oil wells in Canada rose from 703 to 10,885. Most of this increase occurred in the western interior. More than 100 new oilfields were developed in the region in that decade.[6]

Patrick died early in April, 1948, in his home in Calgary, a city he served not only as a pioneer surveyor but as an alderman for two terms of office. His life came to an end just a few months before his 100th birthday anniversary would have occurred. Today an abandoned oil well, a rough wooden sign reading "Oil City, 1878-1954" and several discarded, rusting pieces from a primitive oil rig are all that remain to mark the site of Alberta's first oil strike, an event engineered by a Dominion land surveyor.

21

MEN AND MERIDIANS IN CANADA'S NORTH

"There's nothing situate under Heaven's eye
But hath his bound, in earth, in sea, in sky."

—*The Comedy of Errors*, Act 2, Sc. 1.

Whenever Canadians contemplate the extent and greatness of their country their eyes, generally, are fixed upon east-west lines of sight, all the way from the Atlantic to the Pacific. But north of the 60th parallel of latitude and between the 60th and 141st meridians of longitude the Northwest Territories and the Yukon Territory together comprise more than 1,500,000 square miles, or about one-third of Canada's total land mass. Yet because four out of five Canadians reside within a relatively narrow strip, averaging about 80 miles in depth, adjacent to the United States of America, there is the national tendency to overlook the fact that it is possible to fly in a straight line, south to north in this country, for about 3,000 miles without leaving the air space belonging to Canada.

The importance of the territories at the top of the map of this country can be minimized no longer. In terms of discovery and exploration by the white man Canada's northern regions possess a history as extensive in time as that claimed by any other part of the nation. The Northwest Territories, in fact, rival Newfoundland in length of contact with Europeans. Along with the Yukon these northern regions form a part of Canada that is becoming more and more strategically significant, increasingly attractive as a new and growing field of investment and productive of increasing opportunities for future generations of Canadians.

The long-nurtured popular conception of a single, unvaried, rigorous North has been slowly yielding to the progressive march of greater public awareness and knowledge of this part of Canada. There is no single North but, rather, several distinctive north-lands differing markedly in climate, topography and prospects for development. The high Arctic, for example, bears little resemblance to the lush valleys of the Yukon Territory. The treeless tundra northwest of Churchill shows little in common with farmlands bordering the Mackenzie River. Nor does the hardrock country around Great Bear Lake and Great Slave Lake suggest any similarity to the spongy delta lands in which Aklavik is located.

About half of the mainland area of the Northwest Territories and all of its islands in the Arctic Ocean lie within the Arctic Circle. The eastern two-thirds of the mainland portion and many of the islands form part of the Canadian Shield. This vast land, when viewed from the air, appears as an almost endless expanse of flatlands and countless lakes. Actually the terrain is rough and hilly, consisting mostly of solid rock. But the Territories include Canada's longest river, the Mackenzie, and largest lake entirely within Canada, Great Bear Lake.

The Yukon Territory is a land of majestic beauty, of imposing mountains and lofty hills; of broad, sweeping, silent valleys threaded by swift-running streams. In previous chapters of *Men and Meridians* the Yukon and its dynamic inhabitants have received attention. Surveying and mapping activity in relation to the Klondike gold rush and to the Alaska Highway project have been described. Airborne surveyors photographing its thousands of square miles, land surveyors bounding innumerable mineral claims, discovering and mapping its varied natural features and resources as well as helping to locate its highways and measure its forests; all have contributed to the growth and importance of the Yukon.

True to tradition, surveyors by land, air and water have spearheaded activities devoted to opening up the northern territories of this country to development. Stories of what has been accomplished by some of the durable and dedicated Canadian land surveyors who have been in the forefront of progress in the North, are recounted in the remainder of this chapter.

A well-known Canadian land surveyor whose name is linked with northerly surveys in Canada's western interior also served a term of office, in 1920, as president of the Association of Dominion Land Surveyors. Born in Bruce County, Frederick Victor Seibert (1885-1966) was educated in public and secondary schools in that part of Ontario as well as at the School of Practical Science, University of Toronto. After specializing in astronomy and geodesy Seibert graduated in 1909 and joined a federal topographical survey party operating in the Yellowhead Pass area. The chief of party was Dominion land surveyor John Baird McFarlane.

Seibert was always proud of an ingenious device that he constructed in an emergency during his initiation in the field as a student. It was a roughly made Abney level or, as he described it, a "crude clinometer" made from materials at hand at the time. Seibert used the side of a packing box and a bit of tin punctured by a nail to provide a peephole. The tin was then fastened to one corner of the wooden panel. The latter he shaped into a semi-circle and carved on it degrees and half-degrees. From a nail in the centre of the half-circle the plumb bob was hung. An Abney level is used, of course, to ascertain the slope angle of all tape measurements. Seibert's device was held so that one end of it pressed against the surveyor's shoulder. Seibert claimed that his home-made instrument worked satisfactorily on fairly steep slopes encountered in the course of chaining section lines during that season.

In that same season Seibert nearly lost his life by drowning. His canoe upset suddenly in rough waters of the Snake Indian River, Jasper National Park. He narrowly

FIGURE 161
Seibert clinometer.

survived the mishap but lost the tripod of a transit, some chaining tape and, most serious of all, the field notes belonging to party chief McFarlane covering 50 miles of surveying.

In the seasons of 1910 and 1911 Seibert served on survey parties operating under Dominion land surveyor A. H. Hawkins in the Peace River country, and in 1912 headed a survey party of his own. He was most active in the practice of his profession from 1909 to 1922, a service interrupted briefly by his enlistment in 1917 in the Royal Air Force.

It was in February, 1913, that Seibert received instructions from Ottawa to take a survey party into the field and to run the 21st base line from the Fourth Initial Meridian (Alberta-Saskatchewan boundary) west to the Fifth Initial Meridian. Seibert assembled a group of 23 men for the expedition and it is interesting to note the nature and variety of the contents of his list of provisions for the party:

"Flour, rolled oats, fine and coarse salt, white and brown sugar, rice, tapioca, sago, dried green peas, split peas, apples, tomatoes, lard, raisins, canned peaches, prunes, currants, onions, dehydrated potatoes, macaroni, butter, corned beef, pickles, codfish, jam, jelly, plums, spices, canned pumpkin, buckwheat, tomato catsup, tea, coffee.

powdered milk, cocoa and mapleline from which syrup could be made to go with flapjacks. In addition 400 pounds of bacon and 50 pounds of ham were included, all dried and double-smoked. Another staple, apricots, accounted for an additional 50 pounds."

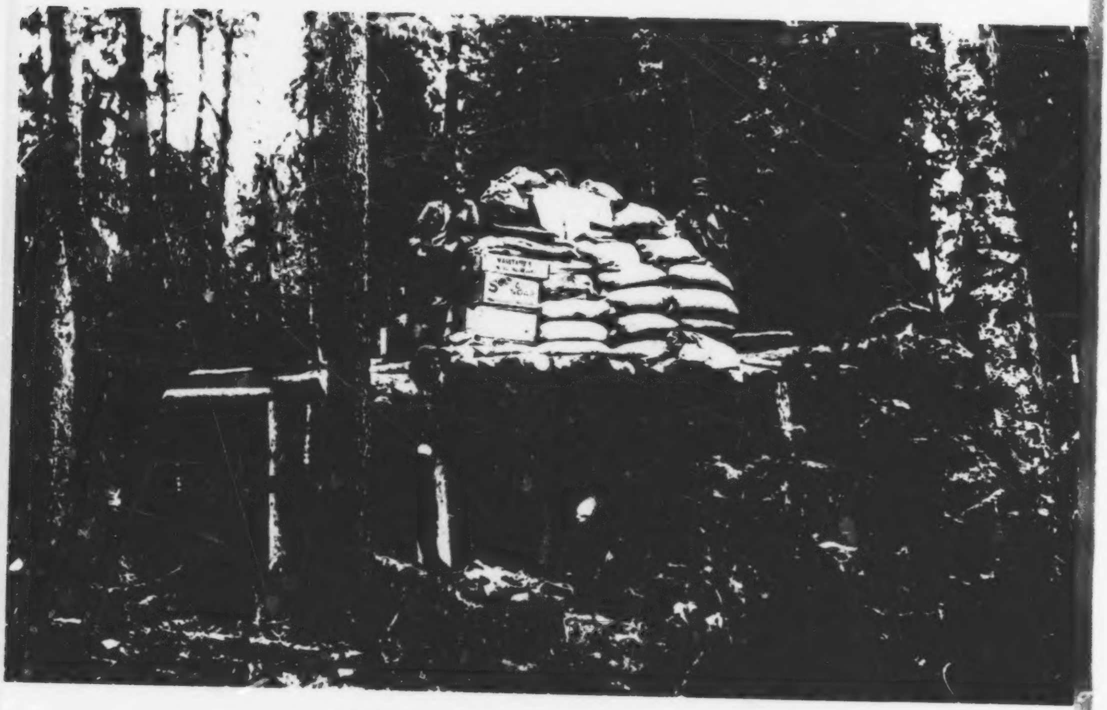


FIGURE 162. Survey cache, 23rd base line, Alberta, 1913.

A half-century later Seibert, in commenting upon this venture, stated, "I left Edmonton early in 1913 with my survey party. The journey to the field took from March 15 to the first day of May! Today a railway to McMurray from Edmonton saves at least three weeks of travel by scow and by pack-horse. In those days we built our own scows. By helicopter, of course, a man can now be lifted over that entire distance in a few hours."[1]

In 1921 The Department of Mines, Ottawa, asked the Topographical Survey Branch, Department of the Interior, to survey the Mackenzie River shoreline, including both banks and all islands, from Great Slave Lake to Fort Norman. The purpose of this exercise was to provide plots of the traverses to geologists in the field and to deliver final plans to the Mines Department by the end of that year. All was carried out efficiently and on schedule. More than 4,000 miles of shoreline were surveyed by three field parties headed, respectively, by G. H. Blanchet, E. P. Brown and W. H. Norrish. Each party, in addition to its chief, had two assistant Dominion land surveyors, one range-finding

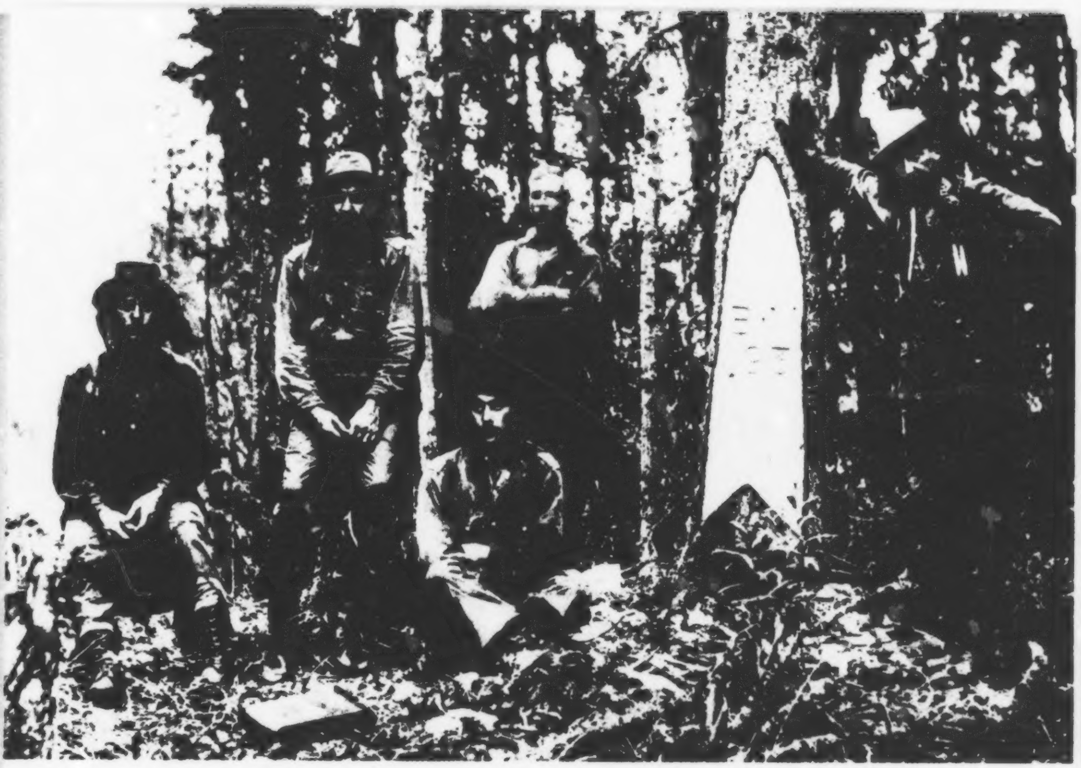


FIGURE 163. Surveyors on 27th base line, Alberta. F. V. Seibert on extreme right.

expert, two rodmen, one draughtsman, four canoemen and a cook. Seibert was given a sort of roving commission in relation to all three parties, with particular emphasis on provisioning them.

Survey monuments were placed by the parties at intervals from 2 to 5 miles on both sides of the Mackenzie River. These markers were intervisible and provided control for all surveys of oil and mineral claims in the region. An essential feature of these survey tasks was the extension into the Mackenzie River basin of the Dominion Lands Survey System, linking it to the already established intersection point of the Sixth Initial Meridian with the 60th parallel of latitude (the northwest corner point of Alberta). Flow measurements were made in important streams, magnetic observations were taken and useful meteorological data obtained.[2]

Late in 1922 Seibert resigned from the Topographical Survey Branch, Department of the Interior, to join the National Development Intelligence Bureau of that department. From that organization he was recruited in 1930 for the staff of the Natural Resources Division, Canadian National Railways. Seibert will be remembered as a surveyor of special ability who helped to open up Canada's northland. An important lake just east of Lac la Biche, Alberta, has been named for him in commemoration of his accomplishments. Seibert was a Canadian who served his country well in wartime and in peacetime as a Dominion land surveyor as well as a qualified surveyor in the provinces of Ontario, Saskatchewan and Alberta.

Frederick Carlyle Lamb (1887-1966) was a Dominion land surveyor and a Saskatchewan land surveyor who participated in northern surveys in his adopted province.

FIGURE 164. F. C. Lamb.

Born in Walkerton, Ontario, Lamb matriculated from high school there and entered the University of Toronto, graduating in 1909. Although he worked as a student on federal summer survey parties in Saskatchewan under Dominion land surveyor James Warren, during several seasons prior to 1910, Lamb did not move permanently to Saskatchewan until that year, making his home in Saskatoon. In his graduation year he worked with J. W. Tyrrell in northern Manitoba. Two years later he was awarded his D.L.S. and S.L.S. commissions.

In 1938 Lamb began work in the North. In that year he assisted the Dominion topographical surveyor C. H. Ney in locating the precise northwest corner point of Saskatchewan. He has described this project as one of the most interesting surveying tasks he ever performed. Night observations were made for latitude readings and fixes. Again, in 1941, Lamb worked with the Dominion, and Manitoba, land surveyor Ed. Gauer on the Manitoba-Saskatchewan boundary.

This prairie surveyor of high repute, whose son J. A. Lamb also became a practising surveyor in Saskatchewan and Alberta, has been accorded permanent recognition in the naming after him of a lake in the Kamsack area of the province he loved and which became his home.

Some aspects of Guy Blanchet's survey work in the Canadian North have already been described in this volume, particularly his part in the building of the Canol pipe line. This Dominion, and British Columbia, land surveyor received his formal education in the capital of Canada and at McGill University, from which he graduated in 1905. From 1910 to 1920 Blanchet surveyed base lines and township outlines, as a member of the Topographical Survey (Interior), in northern districts of the three prairie provinces.

FIGURE 165. Guy H. Blanchet.

Subsequently he explored, surveyed and mapped in the vicinity of Great Slave Lake, along the Mackenzie River and in the Coppermine River area. It was on these assignments in the Northwest Territories that a romance began between Blanchet and Canada's North, a love affair destined to flourish for the remainder of his active days. For years Blanchet surveyed headwaters of rivers of the Far North draining into Hudson Bay and the Arctic Ocean. Many surveyors of note received training in this region from him, men such as Ney, Narraway, Bostock, Wright and Joslyn. Blanchet, among other accomplishments, acquired a working knowledge of the Cree language and could surpass any Indian of that tribe in recounting their traditional legends and anecdotes.

In the 1926 season, while conducting a survey near Fort Reliance, Blanchet met John Hornby and his two companions as they prepared to journey into the barren lands. Blanchet tried in vain to induce the Englishmen to give up their risky venture and to take employment with his field party. The three ill-fated travellers perished, however, in the sub-Arctic wilderness during the following winter. Three years later Blanchet participated in the first search and rescue operation in the Canadian Arctic to make use of aircraft. This expedition was organized in an effort to locate a party of mining promoters led by Col. C. D. H. MacAlpine, a group regarded for a time as "lost" somewhere along the Arctic coast in the course of a flight from Baker Lake to Bathurst Inlet. They turned up, finally, at Cambridge Bay after many adventures and much privation. The imaginative use of aircraft in this search and the wide publicity the rescue operation received, as well as the liaison role played by Narraway, contributed substantially to the increased employment of planes for a variety of purposes in the Canadian North.[3]

More than 29,000 miles were flown during the nearly two months of this first major air search in the history of Canada. But the prolonged operation, extending from September 8 to November 15, 1929, added immeasurably to Canadian knowledge concerning flying in the Far North. In the course of the extensive search a number of pilots became familiar with the barren lands, much of those lands being wholly unmapped at the time. Pilots learned the special techniques of Arctic flying through the risky process of trial and error. The MacAlpine expedition itself had five planes wrecked and one vessel sunk during its sojourn in the North but no lives were lost.

Aeroplanes had been used successfully in the 1920s for observation and transportation purposes in northern areas of Canada. But their range, in those days, was so limited that vast regions of the North lay beyond their winged reach, unless airbases could be established in the North itself for their use, including repair work and refuelling. Chief among those responsible for lifting this logistical idea out of the realm of hope into that of reality was Col. MacAlpine.[4]

Blanchet was a prolific writer, mostly on northern themes, for such magazines as the *Canadian Geographical Journal, The Beaver,* and *The Canadian Surveyor.* An example of the writing of which he was capable at his best is to be found in the following passage from his book concerning the MacAlpine rescue project, ***Search in the North:***

"As the rim of open water evidenced, the blue sea appeared again, rippled by the light wind; once again, after months of silence, when the sea had been scarcely distinguishable from the land, we could hear waves breaking on the beach, singing their old song. The white line of the retreating ice vanished beyond our islands, leaving a rearguard of grim fragments — like ships gleaming in the light of the setting sun. The change had been so sudden it seemed unreal. We had lost our familiar river, the tide gauge, the anchorage markers and the coal sacks that had been our air strip."[5]

In 1921 Blanchet had served as president of the Association of Dominion Land Surveyors, succeeding his friend, F. V. Seibert. A fellow of the Royal Geographical Society, Blanchet's reputation as an authority on the Canadian North was not confined to this country. In 1923 an island in Great Slave Lake was named after him as a tribute to the important role he had played in the development of Canada's North. Blanchet spent the later years of his life in Victoria, dying in the British Columbia capital in August, 1966, at the age of 82.

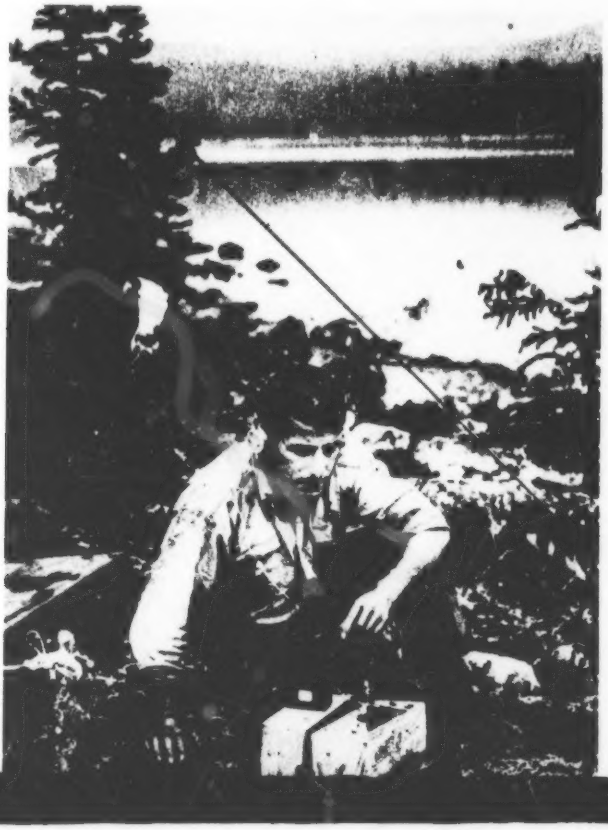


FIGURE 166
Blanchet taking time signals at Upper Taltson River, Northwest Territories, 1925.

FIGURE 167. Survey, 23rd base line, west of 4th meridian, 1911.

Hugh Edward Pearson (1887-), a well-known Edmontonian, associated as a land surveyor with Guy Blanchet at one period of his career in the Far North, was born in Minnedosa, Manitoba, and was educated there. Young Pearson served as a chainman on a section survey near Fort Macleod in the Alberta foothills in 1906. After that experience he was left with vivid recollections of the disaster suffered by southern Alberta ranchers during the extremely severe winter of 1905-06. He saw everywhere in that area the sun-bleached bones of cattle that had starved and then frozen to death in the blizzards of that calamitous season.

The spring of 1907 found Pearson again chaining and digging boundary-marker pits on surveys north and east of Edmonton. That autumn he joined a survey party, headed by Dominion land surveyor, J. L. Côté, then engaged on a survey of timber limits near Fort Assiniboine. This was the beginning of five consecutive seasons on parties under Côté, mostly on subdivision surveys. At Athabasca Landing, for example, 43 sections were subdivided ambitiously into town lots, some of them located on steep hillsides. Such lots were sold to real estate speculators all over the western world. In 1912, when he was commissioned a Dominion land surveyor, Pearson entered into partnership with Côté and Tremblay.

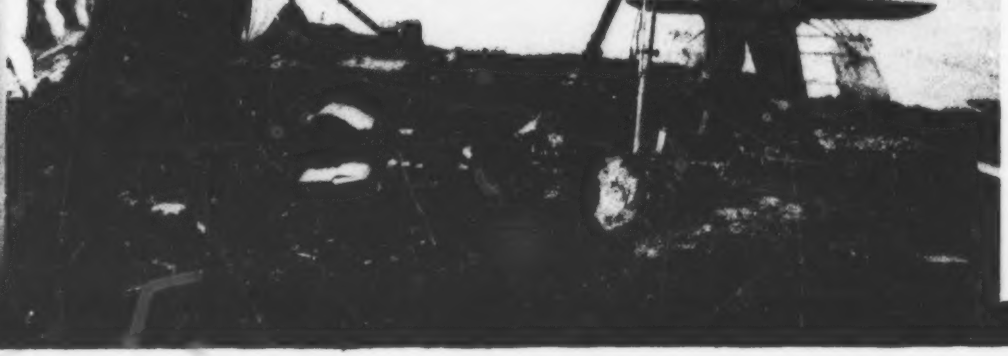
In 1915 Pearson enlisted in a Canadian infantry battalion and served overseas, winning the Military Cross. He was wounded and returned to Canada in 1919. After a season of resurveying sections south of Brandon in his native province of Manitoba, Pearson became active in Canada's North for several seasons in the early 1920s, operating under Guy Blanchet. During the first of these seasons a private survey was made of claims staked at Pine Point, on the south shore of Great Slave Lake, for the Paragon mining group. At intervals since the days of the Klondike gold rush the area had been staked and restaked. As a result considerable confusion existed over the location of boundary lines. Although hundreds of these wooden markers were to be found in the locality, most of the inscriptions on them were beyond deciphering. Pearson, however, discovered a sufficient number of guideposts on which to base a satisfactory survey. On leaving the vicinity he encountered the Erickson brothers of Seattle who revealed that they had staked on what Pearson had assumed was Paragon property. There was no alternative, therefore, but to return to Pine Point and to resurvey there, preserving the Erickson claim intact in the heart of the Paragon holdings.

In those years surveyors generally did not have radio receiving sets in the field although in 1924 the Blanchet party was equipped with wireless in order to receive from the Annapolis Naval Station in Maryland accurate time signals for ascertaining longitude positions. Following that season Pearson travelled to Ottawa where he completed his field notes and brought his career as a surveyor to an end. His interest had been aroused in the commercial possibilities of the newly-developing radio industry in western Canada. In 1927 the Taylor and Pearson radio supply firm was formed and soon began their long-term operation of the *Edmonton Journal* broadcasting station, CJCA.

Another Dominion land surveyor who helped to open up Canada's North, and who also served during 1935 as president of the Canadian Institute of Surveying, was Colin Stone Macdonald (1886-1954). A native of Ottawa and educated in that city, Macdonald gained his first field experience at the age of 16 on a party surveying the route of the National Transcontinental Railway, north of Lake Superior. On his first portage Macdonald, carrying a 100-pound pack of bacon on his back, lost his footing and tumbled down a steep bank and was prevented from falling into the rapids only by the quick action of an alert companion. The young Ottawan was quick to learn the fundamentals of his profession and, with the passing of a preliminary D.L.S. examination, became a member of the Topographical Survey Branch, Department of the Interior, in 1910. Four years later he was commissioned a Dominion land surveyor. During the First World War his career with the federal department was interrupted briefly while he served overseas with the Royal Canadian Engineers.

In 1924 Macdonald was instructed by the Topographical Survey to undertake mapping operations in northern Manitoba and Saskatchewan, mostly by canoe. He selected The Pas as his base and hired his Cree canoemen there. The itinerary of his party included Cumberland House on the Saskatchewan River, Amisk Lake south of Flin Flon, Pelican Narrows, Reindeer Lake, Brochet, and Wollaston Lake. Macdonald observed that from the latter lake — waters of one of its river outlets, namely Fond du Lac, flowed into the Arctic Ocean by way of Lake Athabasca, whereas waters of another outlet, Cochrane River, flowed into Hudson Bay and the Atlantic Ocean by way of Reindeer Lake and Churchill River.

FIGURE 168. Survey work in barren lands, 1931.



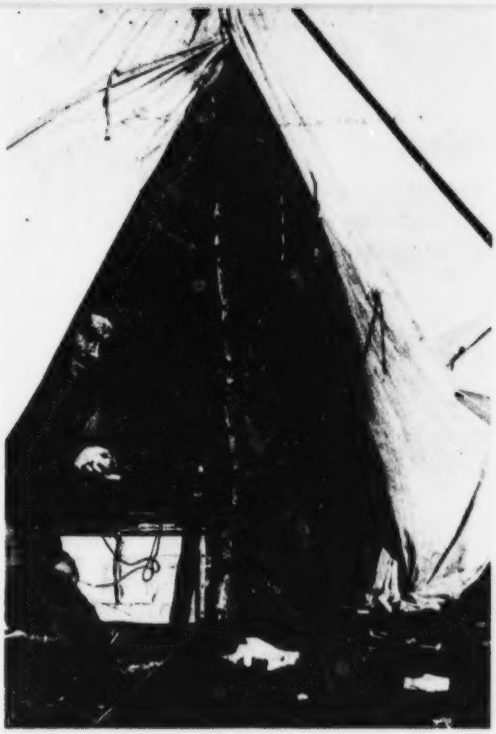


FIGURE 169. Colin S. Macdonald.

Macdonald conducted numerous stadia control surveys for mapping purposes along the Churchill River or in the areas immediately north of that waterway. At intervals he would take observations for latitude and longitude and for magnetic variations. It was on one of these assignments that he experienced in northern Saskatchewan, north of Lac la Ronge, a mishap the consequence of which, in time, brought about his premature retirement. In the 1929 field season Macdonald, in crossing a portage, was at the stern of a canoe being carried by an Indian and himself. The Indian, in a moment of careless high spirits suddenly, at the end of the portage, dropped his end of the craft causing Macdonald to wrench his back painfully. Subsequently this spinal injury brought him increasing discomfort and immobility, especially during the final 15 years of his life.

During 1930 Macdonald was seconded to the Royal Canadian Air Force in order to carry out a comprehensive inspection of gasoline fuel caches for the use of that organization in the Northwest Territories for surveying and transportation purposes. Over the years he had acquired a vast knowledge of Canada's North, especially when he was engaged on ground control surveys that formed such an important part of the framework on which subsequent aerial photographic survey work could be undertaken in that immense region. His contributions to national magazines on the subject of the northland revealed the imposing extent of Macdonald's first-hand acquaintance with that part of Canada, its dimensions, conditions and possibilities for development. Much of this information was gleaned by him in the course of 8,000 or more miles travelled by plane and canoe in the Territories.[6]

In 1931 Macdonald took part in an aerial photographic survey tour of the Northwest Territories, starting at Great Slave Lake and flying over Point Lake to the upper Coppermine River, thence to Bathurst Inlet, Western River, upper Back River to the lower Thelon and Dubawnt rivers. On this flight a total of some 2,800 miles of waterways were photographed. During his most active years in the northland Macdonald and Guy Blanchet were keen rivals in competition for the best record of accomplishment in the field. No history of the development of Canada's North could be complete without an indication of the unique achievements of these two outstanding Dominion land surveyors and explorers.

Dominion land surveyor Robert Archibald Logan (1892-) was closely associated also with pioneer efforts to apply aerial photography in the tasks of mapping in Canada's North particularly. Born and raised in Middle Musquodoboit, Nova Scotia, young Logan decided to follow the example of his grandfather, who had been a land surveyor. In 1909 he had his first taste of surveying in the field in Nova Scotia. In the spring of the following year he received a telegram from Ottawa, telephoned from the local station to his home, stating that he had been appointed as articled student to the Dominion land surveyor, Phidyme R. A. Belanger, and directing him to report to him at Winnipeg as soon as possible. The message was signed *Deville, Surveyor General*. The telegraph operator, unfamiliar with the French language, pronounced the word as *Devil*. Accordingly the intelligence received by Logan over the telephone was that a message had arrived for him from the devil in Ottawa.[7]

During the next several seasons Logan worked as a student in the field under Belanger, Guy Blanchet, Hugh Matheson and George Henry Herriot, all Dominion land surveyors. During the summer of 1913 Logan assisted Herriot in running parts of the 18th and 19th base lines west of the Principal Meridian in the vicinity of the Nelson River in northern Manitoba. It was while Logan was engaged in these tasks that he first became interested in the possibilities of making reconnaissance surveys through the use of aerial photographs.[8] At that time he realized that if only his party had known in advance the relative sizes and positions of lakes and rivers in the district being surveyed, much time and labor could have been saved, the work could have been planned more efficiently and greater accuracy in the topographical mapping work attained. The idea of being able to study the nature of the country from the air and to select the best routes or best bases for triangulation appealed to Logan. He became convinced that before many years had passed surveyors would be provided with aerial photographs and sketch maps produced from them to aid in running survey lines more easily and more efficiently.

At the age of 22, following his field work in the western interior of Canada, Logan won his D.L.S. commission, just a few months prior to the outbreak of the First World War. Soon afterward he joined the Royal Flying Corps and was sent to France. The claim has been made that Squadron Leader Logan, in March, 1916, over German-occupied France, took the first vertical aerial photographs ever credited to a Dominion land surveyor. On that occasion his aircraft was an open-cockpit, 2-seater biplane minus any parachute but equipped with an air-cooled 90-horsepower engine. The airborne camera was attached to the outside of the fuselage at the pilot's right hand. It contained 18 plate glass negatives and the exposure was made by pulling a string. The observer-gunner manned a Lewis machine gun mounted between the two seats.

Over one hour's flying was required in those days for a plane to attain 8,000 feet, the altitude at which the photographs were to be taken. As Logan flew over the front lines of the opposing forces he saw nearby a German plane on patrol over the area. Logan realized that the only way in which his observer could fire at the German aircraft would be while his own aircraft was flying away from it. Accordingly he had to allow the German plane to shoot at him while endeavoring to get into proper position over the area to be photographed. Time and again, while Logan's plane was riddled with bullets he had to take several plate exposures before turning his aircraft so that the enemy fire could be returned. Logan was wounded in the right hand, baring the bone of the middle finger. Although the injury did not prevent use of that hand, blood dripped from it all over the camera. Five times the two aircraft came close enough for a hail of bullets to be exchanged and until a total of 18 plate exposures had been completed by Logan's crew.[9]

As soon as the last plate had been exposed Logan headed for his home base and was astonished to observe that the German plane also was flying away from the scene of their hostile encounter. Fourteen years later, in a most unlikely place, Logan discovered the reason for the abrupt departure of the German. In July, 1930, during a diplomatic reception at the Mexican Embassy in Rio de Janeiro, he met the English-speaking representative of a German aviation firm operating in Brazil. Logan learned from the German in casual conversation that the latter had been a First World War pilot and when the two ex-pilots exchanged reminiscences it was found that they themselves were the combatants who had exchanged gun fire on that March day in 1916. The German war veteran explained that he had been compelled to withdraw from the action because he had run out of ammunition.

On Easter Sunday, 1917, Logan was shot down after a battle in the air, and captured. While a prisoner of war in Germany he prepared a scheme for the resurvey of Nova Scotia. On his return to Canada after the end of the war Logan resumed surveying activity. In the spring of 1922 the federal government decided to send an expedition to the Arctic for the establishment of police posts and further exploration of the region. The Department of the Interior placed the Dominion land surveyor, J. D. Craig, in charge. The authorities at Ottawa, in recognizing the importance of aerial observation in preliminary exploration work and mapping, requested the cooperation of the Air Board. Their most urgent requirement in this matter was an experienced pilot, well qualified in meteorology and navigation, to investigate and report upon flying conditions in the Far North. Logan was chosen for the assignment. The expedition sailed from Quebec on July 18, returning to that port on October 2, 1922, after visiting Baffin, Bylot, Ellesmere and North Devon islands. Logan made a comprehensive report dealing with aviation in the Arctic and the uses of aircraft in the Far North as well as about the nature of ground equipment considered essential for their efficient operation.[10]

Logan, by this time, was convinced that aircraft could facilitate exploration, surveying and mapping of the Canadian Arctic. A passage in the Air Board report for 1922 heralds the advent of the airborne camera as an aid to mapping of the Far North. "The developments during the past year", it is noted, "in the use of aerial photography for exploration and for preliminary survey work also show great promise. The survey services are alive to the importance of the problems. The development of methods of mapping from aerial pictures rests with them. *There is little doubt that the lines on which they are now working will be further developed with far-reaching results.* Even today it is not too much to say, in unsurveyed country, where there are no great differences of elevation, given geodetic control, the topographic detail of the whole district may be filled in from aerial pictures with a speed and certainty unobtainable by any but the most minute ground surveys. *The assistance that aircraft can be to surveyors, geologists and others working in the remoter parts of the country, by providing a rapid, economical, and easy method of transportation is proved beyond all reasonable doubt*" [author's italics].

Five years later Logan was placed in charge of survey work in Central Africa, including air photographic operations in Northern and Southern Rhodesia. These projects involved the taking, along the Zambesi River, of obliques for the production of line maps and of verticals for producing mosaic maps.[11] After Lindbergh's historic transatlantic flight Logan accompanied the United States Air Force colonel on an investigation of northern transatlantic air routes. Ten years later he turned up as head of the Eire Air Force and was the first man in Ireland to greet "Wrong Way" Corrigan on the completion of his famous flight, allegedly made in the direction opposite to that he wished to travel. In 1941 Logan was occupied in surveying base sites for aircraft in Greenland, as part of the allied war effort.

Logan has been, indeed, a man of many parts. A Dominion land surveyor, Provincial land surveyor, Fellow of the Royal Geographical Society, a wartime pilot, a pioneer in aerial photography; he was also a student and authority concerning the Cree (Indian) language and compiled an English-Cree dictionary. He was, as well, a prolific writer on the various subjects that held his interest. A number of his articles are to be found in the pages of *The Canadian Surveyor*.

In 1930 W. G. Jewitt, then a flying geologist on the staff of Consolidated Mining and Smelting Company, made the first geological traverse by air north of Canada's Arctic mainland. He flew from Prince Albert Sound, Victoria Island, to Collinson Inlet, King William Island, mapping an area some 40 to 60 miles in width.

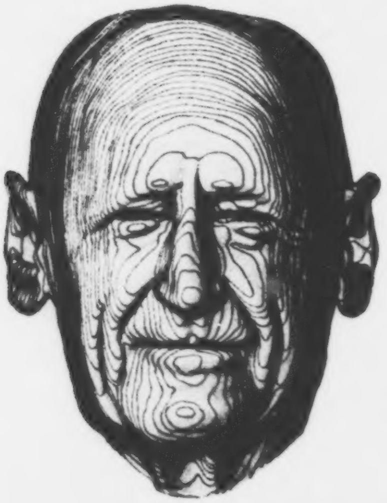


FIGURE 170
H. N. Spence . . . a contoured portrait.

The land surveying career of Howard Nathaniel Spence (1900-), who performed a considerable amount of work in the Yukon Territory for the Topographical Survey, straddled two fairly well defined periods in the recent history of Canadian surveying field work. During the first half of his professional life an important feature or requirement of activity in the field was physical prowess. On chain traversing Spence had the reputation of keeping an assistant moving along the line at a dog trot. On triangulation work it was asserted that Spence had achieved the remarkable feat of accomplishing

80 climbs of mountain peaks within a span of 100 days! In any event the competitive spirit was strong among surveyors of that period in the attainment of a high volume of work by intensive physical exertion. In the case of Spence he believed that total advantage ought to be taken of any existing conditions favorable to the performance of a survey. Even during periods of inclement weather his restlessness sought outlet in planning "tomorrow's work".

The second half of the working life of Howard Spence was marked by the advent and development of the use of aircraft and of electronic instruments, a combination that tended to diminish the significance of the surveyor's physical endowments and endurance. In fact, the contribution made by Spence through promoting the application of the helicopter to control surveys in Canada is a noteworthy one. As early as the season of 1948 Spence was in charge of a helicopter operation destined to take place in Canada's northwest. But the venture proved abortive when the aircraft involved faltered in flight soon after its departure from Vancouver. It was about this time that the helicopter came into experimental and rather limited use in Canadian geodetic survey work along the Alaska Highway.

In the following season, 1949, on the opposite side of the continent a helicopter was placed in charge of Howard Spence who headed a survey party of seven, including a cook. The purpose of this field operation was to obtain horizontal control required to map an area of about 6,000 square miles in the Knob Lake area of Quebec-Labrador. The type of helicopter selected after careful study was capable of carrying a pay load of 450 pounds, including two surveyors. The ability of this craft to hover at heights as high as 6,000 feet proved invaluable, especially in the selection of sites for triangulation stations. Prefabricated, 12-pound survey signals were used. The helicopter pilot was provided with photographic mosaics of the area to be mapped. Spence's conclusion, after the successful operations of that season, was that the use of the helicopter for survey work under such conditions would be practical and economical and he strongly recommended the increased use of helicopters by the Topographical Survey (Canada).[12]

FIGURE 171. Topographical surveyors checking on day's work in Knob Lake area.

As a result of the experience and perception of Howard Spence two helicopter operations were arranged by Topographical Survey in the following season, one of which was placed in his charge. Spence helped bring about the rapid transition from single-season surveying projects that covered a relatively limited area of, say, several hundred square miles, to those embracing a region of several thousand square miles. He earned the genuine respect of aviation firms and resource development industries associated with his survey activities. In the field Spence's subordinates were driven hard by their chief but he always evinced a deep personal interest in his men as individuals and a real concern for their welfare.

In 1967 Howard Spence retired as chief of the field surveys section of the Topographical Survey, an event appropriately observed by his many friends at a large function held in Ottawa. This occasion marked the completion of 44 years of action and achievement in the realm of surveying and mapping, a substantial portion of that lengthy period having been served in the Canadian North.

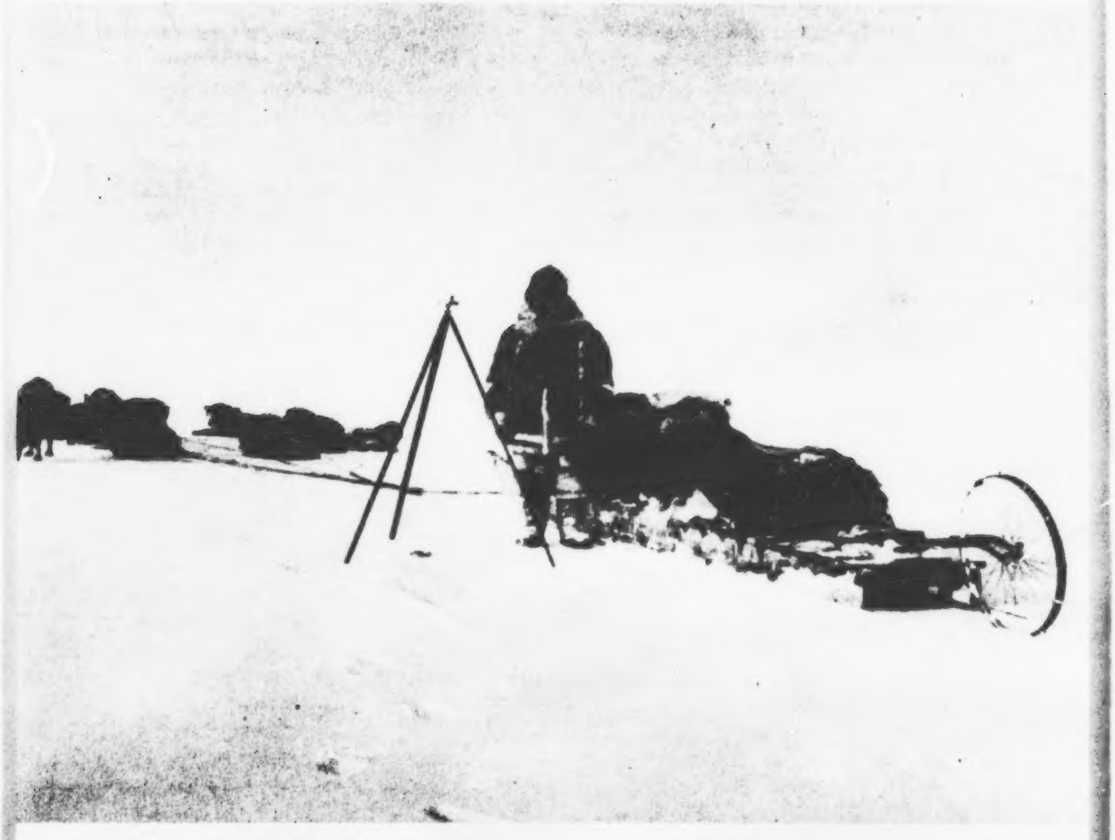


FIGURE 172. Winter survey work, using prismatic compass and odometer, Baffin Island, 1927.

Airborne Profile Recorder

Special mention should be made in this chapter of a distinctively Canadian invention — the Airborne Profile Recorder — by means of which information was compiled in extensive areas of Canada's North (as well as in other regions) enabling the profile, or critical heights of land features, to be mapped on aeronautical charts speedily and economically. In the years following the Second World War the instrument, known in the initial stages of its development by the rather cumbersome name — Narrow Beam Recording Radar Altimeter — was highly useful in establishing elevations of shoran geodetic stations in the Canadian Arctic. On the islands, vertical control was established by the Airborne Profile Recorder lines run from sea level to sea level. But the use of this instrument was not confined to the North nor to Canada only.

The Dominion land surveyor Bruce Wallace Waugh who was, at the time, assistant to Surveyor General Peters in Ottawa, succeeding him in that position in 1948, faced a pressing wartime problem in aeronautical charting. During the early years of the Second World War demands had mounted swiftly for accurate, detailed aeronautical charts of Canadian territory. In about 70 per cent of the whole area of the country the federal government found it imperative to map the ground profile speedily for the purpose of indicating critical heights on such charts.[13] Waugh had heard an address by R. C. Newhouse in 1939 descriptive of a new instrument named the Terrain Clearance Indicator. Newhouse was then a scientist employed in the Bell Telephone Company laboratories in New York City and his paper on this subject had been delivered to the American Society of Photogrammetry meeting in Washington, D.C. That address stimulated Waugh's thinking on what seemed to him to be a promising practical application of the Indicator, namely, an electronic device, mounted in aircraft, capable of measuring altitudes continuously along a flight track.

On June 1, 1943, Waugh wrote to Newhouse stating in part:

"What we need is a Terrain Clearance Indicator that will read distances up to 4,000 feet with a maximum error of 100 feet or so. We would like to have it fitted with a continuous recording device so that if a plane is flown at a constant elevation, the resulting graph will be a profile of the terrain traversed. This, together with an altigraph record of the up and down flight path of the plane and a record of the barometry gradient in the area, should give a fair indication of the elevation of the ground above sea level."[14]

Because of the vital interest of the Royal Canadian Air Force in the production of adequate aeronautical charts, the federal survey organization was provided with Hudson aircraft and equipment so that Waugh's idea could be tested. The Terrain Clearance Indicator operated on frequency-modulated radio principles and was designed to determine the critical altitude of an aeroplane above the sea for the launching of torpedoes at enemy ships or submarines. The first of several secret flight trials was carried out in September, 1943, and these tests proved encouraging over water surfaces although the instrument's performance over rugged land surface left much to be desired. This shortcoming was discussed with the National Research Council of Canada and the survey organization was advised that an Indicator based on radar-pulse principles would be more effective. However, it was also pointed out that the production of such a device would need to await the end of hostilities.

The National Research Council was approached again on this subject after the end of the war. With Sid Jowitt of the Topographical Survey staff assisting, work on the project was resumed in close cooperation with the Royal Canadian Air Force and the National Research Council. In 1947 a member of the Council staff, Brian Cooper, designed and constructed for topographic surveys the terrain clearance indicator named Narrow Beam Recording Radar Altimeter. Another requirement in Waugh's proposed new survey technique was an altigraph record of the up and down flight path of an aircraft. Ray Westby, also of the Council staff, designed and built a special auxiliary instrument for this purpose, named a Pressure Height Corrector. This instrument automatically corrected terrain clearance measurements. As a result the altimeter accurately recorded the profile of the terrain even when a pilot failed to maintain a constant flight level. A third improvement in the recording instrument was made by T. J. G. Henry of the federal Department of Transport, who suggested a meteorological formula for evaluating barometry gradients at altitudes above the frictional effects of the earth's surface. Because the Narrow Beam Recording Radar Altimeter was designed to record the profile of the ground, similar equipment was later known as the Airborne Profile Recorder.

Waugh's new surveying technique was thoroughly tested in 1948. Flight trials, arranged by the Royal Canadian Air Force in that year with Jowitt aboard, demonstrated the success of the apparatus beyond the most optimistic expectations. Some of the traverses extended 350 miles between ground control points and the accuracy of results was astonishing. The average error was plus or minus ten feet only. This represented a far higher order of accuracy than was required for aeronautical charting. The new technique also showed considerable promise of usefulness in larger scale topographical mapping.

In 1949 the Royal Canadian Air Force ordered six sets of the Airborne Profile Recorder for its use. In that same year the first of several private Canadian air survey firms to make use of the Airborne Profile Recorder device equipped itself with a set and was awarded a contract to survey an extensive area in Quebec and Labrador. In fact, private aviation firms in Canada have been responsible for significant refinements in this equipment during the years following its official adoption for surveying purposes. The Airborne Profile Recorder not only produced excellent results when used in Canada; sets made in Canada were purchased by agencies in the United States, England, Australia, Holland and Pakistan, among other countries. The instrument has been used by private Canadian companies to map extensive areas in countries of Central and South America as well as countries in Africa. In areas totalling between 50 and 60 per cent of all Canada, including its Arctic regions, the Airborne Profile Recorder was used as a means of providing information for contouring aeronautical charts and later, as additional improvements were made in the device, for 1:250,000 topographical maps.

SURVEYORS GENERAL
(Federal)

	Years in office
John Stoughton Dennis, P.L.S. (Ontario).	1871-1878
Lindsay Russell, D.L.S.	1878-1884
Edouard Gaston Daniel Deville, LL.D., D.T.S., D.L.S.	1885-1924
Frederic Hatheway Peters, O.B.E., D.L.S.	1924-1948
Bruce Wallace Waugh, D.L.S.	1948-1953
Robert Thistlethwaite, D.L.S., B.C.L.S., A.L.S.	1953-

APPENDIX

INCORPORATION OF SURVEYORS' ORGANIZATIONS (MARITIME PROVINCES)

New Brunswick

The year 1954 proved to be an historic one in the formation of an organization of land surveyors in New Brunswick. In the years between the two world wars several attempts were made in New Brunswick to arouse interest in the creation of a province-wide association of this nature but these efforts foundered on the shoals of apathy. By 1950, however, the need for such an organization had become more apparent than ever. In September, 1953, several New Brunswick land surveyors gave leadership in this project by circulating a questionnaire among fellow professionals resident in the province. Each surveyor was asked to express his opinion for or against the idea of a provincial association. Of the 93 forms mailed out, 53 replies favorable to the proposal were received, none against. Elated by this response the core group sent out a second circular containing information that an organizational meeting would be held on November 16, 1953, in Fredericton.

At the November meeting, attended by 39, the provisional Association of New Brunswick Land Surveyors was organized. A president, W. F. Roberts, was named along with a vice-president, eight councillors and a secretary-treasurer. The meeting passed a motion authorizing the Council to call a first annual meeting to take place on January 12 and 13, 1954, and passed as well a motion authorizing the preparation of a draft act of incorporation to be submitted, on proper approval, to the Provincial Legislature. At the conclusion of this historic meeting the new president distributed to each councillor, for his guidance, a set of the various provincial acts passed in Canada establishing surveyors' organizations. Each councillor was requested to form and to preside over a committee in his own area in order to study these acts and to select sections of such legislation or to suggest new sections suitable to be included in a New Brunswick act. All were asked to have reports ready for consideration at a meeting to take place on December 28, 1953.

At this deliberation of councillors the rough draft of an act was compiled from the various area reports received. During the first few days of January copies of the compilation were produced for consideration at the first annual meeting of the association in Fredericton. The weather on January 12 threatened to abort the birth of the new body. One of the worst blizzards of the winter did leave some members firmly snowbound in their homes. But enthusiasm had been running high for the incorporation project and, despite the hostile elements, 41 surveyors arrived for the occasion. A draft bill was given careful study, section by suggested section. In the course of a day and a half the complete text was approved unanimously. A leading lawyer in Fredericton spoke to the meeting on various legal aspects of the draughting of such a measure. At the formal dinner on January 12 the gathering was addressed by Hon. N. B. Buchanan, Minister of Lands and Mines, New Brunswick. At luncheon, on the following day, the special speaker was W. H. Miller, Director, Surveys and Mapping Branch, Ottawa.

Throughout February, 1954, officers of the embryo organization met on a number of occasions with the solicitor to the association in clarifying and adding finishing touches to the bill. Finally the measure was judged ready for consideration by the Provincial Legislature then in session. Suspense among the surveyors began to build up as the time for parliamentary discussion approached. On March 10 the measure, Bill No. 38 of that session, passed its formal first reading stage, with second reading taking place on the following day. The bill was then referred, according to custom, to the corporation committee of the Legislature. On March 18, 1954, the entire membership of the Council of the association, together with its solicitor, appeared before the legislative committee which then proceeded to examine the bill, section by section. By noon of that day the representatives of the association were asked to re-word two sections and to appear again before the committee later that day. One of the revised sections, that of authorizing entry to properties for measuring purposes, continued to arouse objections and was discarded. The re-wording of the other disputed section, relating to the custody of field notes of deceased surveyors, was accepted and the bill was given final approval for submission to the committee of the whole house.

To the dismay of the surveyors the latter body returned the bill to the corporation committee for clarification of the right to survey a highway or street. Accordingly, on legal advice, the councillors of the association dropped this provision and inserted a new section, giving all persons working under the Highway Act of the province the right to survey their highway location. On March 24 the newly added section having met with approval, the bill was safely navigated through the remaining stages of legislative discussion and received royal assent on April 12, 1954.

At the time of incorporation of New Brunswick surveyors their first president, Willis F. Roberts, was a forester on the staff of the photogrammetric and survey branches of the Department of Lands and Forests, New Brunswick. Roberts had graduated from the University of New Brunswick in forest engineering. In 1955 he was appointed assistant director by H. P. Longley. Other officers elected that year were C. F. Cook, vice-president, and J. R. Bedard, secretary-treasurer. Councillors chosen were C. B. McKiel, R. S. Jones, H. G. Rogers, W. I. Spence, G. D. Hughes, E. R. Jamieson, R. G. Brown and C. M. Roy.

Nova Scotia

The Association of Nova Scotia Land Surveyors, as it is now known, came into existence following a series of attempts to organize members of the profession on a provincial basis. On October 10, 1924, for example, a group of land surveyors practising in the province met at Middleton and decided that it would be in the best interests of the general public and of the profession to form an Association of Provincial Land Surveyors of Nova Scotia. With this object in view all surveyors qualified to practise in the province were circularized. They were asked to meet for organizational purposes in Halifax on November 21, 1924. About 50 persons turned up for that meeting and a number of communications were received from the absent but eligible remainder indicating agreement with the purpose of the event. At the meeting the proposal to form such an association was endorsed unanimously. Officers elected to prepare a draft constitution for submission to a general meeting to take place in January, 1925, included the chairman of the preliminary gathering, J. R. MacKenzie of Halifax (subsequently named association president); J. R. MacKenzie of Springhill (named vice-president) and Professor W. G. Hardy (Nova Scotia Technical College) secretary-treasurer. Elected to the Council were J. R. Morrison, J. Lorne Allen, Otto Schierbeck, H. J. Congdon and F. H. Hanson, deputy minister of Crown Lands for the province.

As chairman of the October, 1924 gathering J. R. MacKenzie set forth six main points representing aims of the proposed new organization, namely:

1. All new surveys be performed by transit to the true meridian and the compass be allowed only in retracing old lines.

2. To avoid confusion between the two meridians all descriptions of lands in deeds and leases should be written and certified by a member of the association.

3. In order to make surveys of permanent value all surveys executed by members should be filed with the association secretary until a provincial government department could be formed to deal with such work.

4. To induce the government of the province to have all Crown Lands surveyed by association members.

5. To induce the government to have cadastral surveys started by surveying and placing permanent monuments at all suitable points along all county, township lines and public highways.

6. An agreed standard scale of fees be charged by association members.[1]

In 1928 Bill No. 58 was introduced in the Provincial Legislature, "an act to incorporate

. . . and to facilitate the acquirement and interchange of professional knowledge among its members." First reading of this measure was accomplished on February 24, following which the bill was rejected. After this set-back organizing activity among surveyors dwindled rapidly and, in fact, disappeared entirely for upwards of a quarter-century. Enthusiasm for the creation of a province-wide association revived about the mid-century mark.

In December, 1950, several provincial land surveyors who were especially eager to promote an association of their fellow professionals in Nova Scotia met, with Professor Piers serving as chairman, in the Technical College building in Halifax. Edward Otis Temple Piers, a graduate in civil engineering from McGill University, had been Dean of Engineering at Mackenzie College in Sao Paulo, Brazil, from 1910 to 1931. Returning to Canada he had specialized in highway engineering and had made his home in Halifax after 1936. Professor Piers, from time to time, has been described as the "father of the (N.S.) Association". It is certain that without his vision and persistence the development of the provincial organization would have been long delayed. He and Professor (Colonel) Spencer Ball, also of the Technical College staff, were largely instrumental at this time in reviving and bringing to fruition the earlier concept of a province-wide organization of land surveyors.

Col. Spencer Ball was trained in civil engineering at the University of Saskatchewan. When the First World War broke out he enlisted in the western universities battalion. C. J. Mackenzie, also of the University of Saskatchewan, and in later years president of the National Research Council, was Spencer Ball's platoon officer at the time. After the war Col. Ball was associated for some years with the Ontario Hydro Commission. He served with the Directorate of Military Training, Ottawa, during the Second World War, after which he practised his civilian profession as consulting engineer, including land surveying and bridge approach work.

In February, 1951, at a meeting also held in the Technical College and marking the first successful attempt to form a land surveyors' organization in Nova Scotia, Professor Piers was elected president, J. G. Mackenzie, vice-president and W. A. G. Snook, secretary-treasurer. Council members included J. E. R. March and F. Tupper from Halifax County; R. E. Dickie and Major J. A. H. Church from outside the Halifax area, and A. H. Martell from Cape Breton.[2] The purpose of the revived organization, as expressed at the time, was to promote the common welfare of surveyors of the province, to maintain standards of ethical conduct in the practice of the profession in Nova Scotia, and to provide opportunities for common action in all matters concerning the association in its relations, and those of its members, with the general public.

The next step, following the formative meeting in 1951, was to arrange for incorporation. For this purpose the first directors of the Association of Provincial Land Surveyors of Nova Scotia were J. E. R. March of Halifax, R. Eric Millard of Liverpool, Roy M. Schofield, Freeman Tupper and J. L. Reid, all of Dartmouth. The objects of the organization, as set forth in the official memorandum over these names, were described as (a) to foster and promote the practice of land surveying and to provide for the betterment of the members and for uniformity and efficiency in land surveying; (b) to formulate and administer policy and discipline among its members; (c) to provide for professional, educational, social and recreational activities and (d) not to engage in the carrying on of any trade, industry or business.

Rather impulsively, and without first obtaining legal advice, the enthused surveyors submitted a draft measure to revise the existing Provincial Land Surveyors' Act and submitted the draft to the legislative committee of the Provincial Legislature. This committee returned the measure without approval, recommending that legal assistance be obtained in the wording of the bill. Compliance with this suggestion involved a delay of 18 months. In the meantime the surveyors grew restive over their unincorporated condition and decided to press ahead with their efforts to become a legal entity. The statutory instrument selected for this purpose was the Societies Act (1953) of the province. Under a certificate issued by the Registrar at Halifax, under provisions of that act, the Association of Provincial Land Surveyors of Nova Scotia was declared to be duly incorporated on January 26, 1955.

After a succession of drafts had been prepared for the purpose of merging the act of incorporation and the provincial surveyors' statute, an Act to revise chapter 230, Revised Statutes of Nova Scotia (1954), being the Provincial Land Surveyors' Act, originally known as Bill No. 16, received royal assent at last on March 26, 1959.[3] Under authority of that measure the Association proceeded to organize a board of examiners, to compile a code of professional ethics and to establish standards of work. By this time membership in the organization had risen to 130.

Col. Spencer Ball, after serving as president, was made an honorary member of the organization as, in time, were Reginald E. Dickie, R. E. Millard (editor of The Nova Scotian Surveyor), Col. C. C. Lindsay, Q.L.S. of Montreal, Robert A. Logan, D.L.S., and J. E. R. March.

One of the sponsors in 1928 of Bill No. 58 was Stephen Edgar March (1870-1966). Son of a Baptist minister S. E. March began his career as a lawyer following graduation from Dalhousie University in 1893. In March, 1915, he qualified to practise in Nova Scotia as a provincial land surveyor. His final active year in the profession was 1951. At the age of 81 he had the largest private surveying practice in the province, though not the most lucrative. In 1937 S. E. March was appointed a magistrate at Bridgewater, Nova Scotia, and served in that capacity until near the year of his death at the age of 96. His son, John Edgar Ruskin March entered, in 1933, into what proved to be a long period of continuous service with the Department of Lands and Forests of Nova Scotia. In 1948, after a number of years in the position of Assistant Director, "Rusty" March, as he was known in the profession across Canada, was appointed Director of Surveys for the province.

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3. *Nova Scotian Surveyor*, v. 9, no. 19, p. 1 (May 1959).

ACKNOWLEDGMENTS

In the course of research activity and other preparatory work involved in the writing and production of this third volume of *Men and Meridians* I have had valuable assistance from sources not already acknowledged in the previous two volumes of this history. In order to make my expressions of appreciation more complete I wish to include, at this time, mention of the following individuals and agencies:

Assistant Deputy Minister J.-P. Drolet, Brigadier L. J. Harris, Angus C. Hamilton, J. B. O'Neill, J. I. Thompson, Dr. C. S. Lord, G. S. Daughtry, L. A. Williams, J. M. McGuire, W. Winges, A. C. Stolzman, W. D. Stretton, Lieut. G. Spearman, D. Howard Bagguley, G. Fremlin, G. Falconer, Malcolm Thomson, George Wood for his sketch maps, M. Wuhr, D. F. Miller, E. G. Jessiman and Ron Cameron, all of the Department of Energy, Mines and Resources, Ottawa; the chiefs and staff members of the Directorate of Map Production (formerly the Map Compilation and Reproduction Division), Surveys and Mapping Branch as well as of the Public Relations and Information Services Branch (including its photo services) of that same federal department; Russell K. Odell, Mrs. J. A. H. Church, Miss Alison Dickison, (Mrs.) Dorothy Brabazon Turpin, (Mrs.) Marguerite Boucher, W. J. Gordon Wadsworth, O.L.S., Col. C. C. Lindsay, Q.L.S., Dr. W. G. I. Creighton (Deputy Minister, Lands and Forests, Nova Scotia), Ivan Macdonald, D.L.S., N.S.L.S., Burton Robertson, N.S.L.S. (Director of Surveys, Nova Scotia), J. E. R. March, N.S.L.S., George E. Streb, J. Ryan, N.S.L.S., M. A. La Salle and Herbert Fletcher of the Canadian Good Roads Association, Ottawa office, Lloyd Walker and staff of the Air Photo Library, Ottawa, and of the Air Photo Unit, Canadian Forces Base, Rockcliffe, Dr. Donald A. MacRae and Dr. John F. Heard of David Dunlap Observatory, University of Toronto, H. E. Mindak, P. T. D. Baldock, and Mrs. R. Trevor, Ottawa, also Principal J. F. Doig of the N.S.L.S.I., Lawrencetown.

I wish also to repeat my special thanks to Douglas A. Shenstone, active in the editing of all three volumes of *Men and Meridians*, ably assisted on Volume Three by Vincent McBride, and to Florence Stephens for typing all manuscript in preparation for printing.

DON W. THOMSON

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[6] C. S. Macdonald, D.L.S., "The Northwest Territories of Canada". *Can. Geog. J.*, v. 2, no. 1 (Jan. 1931), p. 3.
Also: *Can. Surveyor*, v. 4, no. 7 (June 1933), p. 3.

[7] R. A. Logan, D.L.S., P.L.S., F.R.G.S., "Echoes". *Can. Surveyor*, v. 12, no. 5 (Oct. 1954), p. 317.

[8] Proc. 17th Ann. Meeting, Assoc. D.L.S., 1924, p. 51.

[9] Letter dated July 28, 1964, R. A. Logan to D. W. Thomson.

[10] Ann. Rept. Air Board for 1922, p. 50. King's (Queen's) Printer, Ottawa, 1923.
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[11] R. A. Logan, D.L.S., P.L.S., F.R.G.S., "Some Aerial Surveys in Northern Rhodesia". *Can. Surveyor*, v. 4, no. 3 (1931), p. 3.

[12] H. N. Spence, "Helicopter Operation, Knob Lake, 1949". *Can. Surveyor*, v. 10, no. 7 (Jan. 1951), p. 2.

[13] "Airborne Profile Recording Activities, Dept. Energy, Mines and Resources, Ottawa". *Can. Surveyor* (Supp.), v. 22, no. 2 (June 1968), p. 259.

[14] Letter dated June 1, 1943, B. W. Waugh to R. C. Newhouse, file no. 61936, Hydrographic and Map Service, Dept. Energy, Mines and Resources, Ottawa.

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